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101 Oil-based Drilling Muds: Off Structure Monitoring — Beaufort Sea

Canada

June 1988

The Environmental Studies Research Funds are financed from special levies on the oil and gas industry and administered by the Canada Oil and Gas Lands Administration for the Minister of Energy, Mines and Resources, and by the Northern Affairs Program for the Minister of Indian Affairs and Northern Development.

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Environmental Studies Research Funds
Report No. 101

June 1988

OIL-BASED DRILLING MUDS:
OFF STRUCTURE MONITORING - BEAUFORT SEA

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89-06075/

The correct citation for this report is:

Erickson, P., B. Fowler and D. Thomas. 1988. Oil-Based Drilling Muds: Off Structure Monitoring - Beaufort Sea. Environmental Studies Research Funds Report No. 101. Ottawa. 192 p.

Published under the auspices
of the Environmental Studies
Research Funds
ISBN 0-921652-00-3
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TABLE OF CONTENTS

Page

TABLE OF CONTENTS iii

LIST OF FIGURES vi

LIST OF TABLES viii

SUMMARY ix

RESUME xi

INTRODUCTION 1

SUMMARY OF THE USE OF OIL-BASED MUDS IN THE BEAUFORT SEA 1

ENVIRONMENTAL EFFECTS ASSOCIATED WITH THE MARINE DISPOSAL OF OIL-BASED MUD CONTAMINATED DRILL CUTTINGS IN THE NORTH SEA 2

REGULATORY GUIDELINES FOR THE USE OF OIL-BASED DRILLING FLUIDS ON CANADA LANDS 3

STUDY RATIONALE AND OBJECTIVES 4
- a) Study Rational 4
- b) Objectives 6

METHODS 8

SAMPLING DESIGN AND RATIONALE 8
- a) Definition of the Impact and Control Areas 9
- b) Number and Allocation of Samples to the Impact and Control Areas 10
- c) Study Variables 12
- d) Other Sampling Straegies 13

SAMPLING 13
- a) Positioning 16
- b) Sediment Traps 16
- c) Current Meters 17

TABLE OF CONTENTS, cont'd.

Page

HYDROCARBON ANALYSES 18
- a) Materials 18
- b) Extraction Methods 18
- c) Instrumental Methods 19
- d) Quality Control and Quality Assurance 22

DETERMINATION OF VISTA BASE OIL DETECTION LIMIT 26

BARIUM ANALYSES 33

PARTICLE SIZE ANALYSIS 33

RESULTS 35

SEDIMENT GRAIN SIZE 35

ANALYSIS OF THE GRAIN SIZE RELATIONSHIP FOR BARIUM AND HYDROCARBONS 35
- a) Barium 38
- b) Vista ODC 38
- c) Excaid 90 Base Oil 38
- d) PAH 42

CORE SAMPLES 42

TOTAL ALKANES 44

CURRENTS 44

DISCUSSION 45

DISPERSION OF OBDM 45
- a) Post-Drilling Samples at Minuk (Series 4) 45
- b) Samples from Minuk at the end of the Following Open Water Season (Series 5) 47
- c) Post-Drilling Samples from Kaubvik (Series 6) 52

TABLE OF CONTENTS, cont'd.

Page

ADEQUACY OF SAMPLING PLAN 55

WEATHERING AND FATE OF BASE OILS 56
- a) Weathering 56
- b) Estimate of Oil in Surficial Sediments around Minuk and Kaubvik 58

RELATIONSHIP OF THE DATA TO OTHER BEAUFORT SEA LOCATIONS 63

ACKNOWLEDGEMENTS 63

LITERATURE CITED 64

APPENDIX A: SUMMARY OF MINUK I-53 HYDROCARBON, GRAIN SIZE AND BARIUM DATA FOR ALL STATIONS AND SAMPLING TRIPS 68

APPENDIX B: SUMMARY OF KAUBVIK I-43 HYDROCARBON, GRAIN SIZE AND BARIUM DATA FOR ALL STATIONS AND SAMPLING TRIPS 119

APPENDIX C: CURRENT METER DATA FOR MINUK I-53; AUGUST 30 - OCTOBER 10, 1985 AND NOVEMBER 1985 152

APPENDIX D: SUMMARY OF PAH ANALYSES OF 25 SELECTED SAMPLES FROM KAUBVIK I-43 AND MINUK I-53 173

APPENDIX E: NON-POLAR HYDROCARBON DATA FOR INDIVIDUAL COMPONENTS IN 9 SAMPLES ANALYSED IN DUPLICATE AS BLIND SAMPLES 183

LIST OF FIGURES

Page

Figure 1. Location of Minuk I-53 and Kaubvik I-43 in the south-eastern Beaufort Sea. 5

Figure 2. Cross-section profile: a) sacrificial beach island, Minuk I-53, and b) caisson retained island, Kaubvik I-43. 7

Figure 3. Sampling strata and outline of ice rubble boundary at the Minuk Island, winter 1986. 11

Figure 4. Gas chromatogram of the aliphatic fraction of Vista ODC base oil. 27

Figure 5. Comparison of gas chromatograms of the aliphatic fraction of Vista base oil, background sediment and background sediment spiked with 25 ppm of Vista oil. 30

Figure 6. Detection limit for Vista ODC as a function of particle size. 31

Figure 7. Comparison of gas chromatograms of aliphatic fraction of Vista ODC and Escaid 90 base oils. 32

Figure 8. Triangular plots of grain size for samples collected near Kaubvik I-43 and Minuk I-53. 36

Figure 9. Log_{10} Barium concentrations vs sediment particle size for post-drilling samples at Kaubvik and Minuk (95% confidence limits for series 2 and 3 data respectively are shown as solid lines). 39

Figure 10. Log_{10} Vista concentrations vs sediment particle size for post-drilling samples at Kaubvik and Minuk (95% confidence limits for series 2 and 3 data respectively are shown as solid lines). 40

Figure 11. Total PAH vs sediment particle size for post-drilling samples at Kaubvik and Minuk (95% confidence limits for series 2 and 3 data respectively are shown as solid lines). 43

LIST OF FIGURES, cont'd.

Page

Figure 12. Progressive vector plots of current data 1 km south of Minuk I-53; a) August 30 - October 10, 1985 and b) November 12 - November 20, 1985. 46

Figure 13. Contour plot of excess Ba in sediment at Minuk I-53 in April 1986, within 2 weeks of drilling completion. 48

Figure 14. Contour plot of Vista ODC sediment concentration at Minuk I-53 in September, 1986, one open water season after drilling. 49

Figure 15. Gas chromatogram of aliphatic fraction of a sediment sample 950 m to the west of the Minuk Island Centre, series 5 (one open water season following drilling). 51

Figure 16. Relationship between Vista concentrations and Ba in follow-up sampling at Minuk and post-drilling sampling at Kaubvik. 53

Figure 17. Contour plot of post-drilling Vista ODC sediment concentrations at Kaubvik I-43, August 1-4, 1987. 54

Figure 18. Gas chromatograms of the aliphatic fraction of follow-up sediment samples (series 5) containing vista base oil at Minuk I-53. 57

Figure 19. Gas chromatograms of aliphatic fraction of post-drilling sediment samples (series 6) containing Vista and Escaid 90 base oil at Kaubvik I-43. 59

Figure 20. Gas chromatogram of the aliphatic fraction of solid material collected in a sediment trap at Kaubvik I-43 between October 10, 1986 and August 3, 1987. 60

LIST OF TABLES

Page

Table 1. Physical Characteristics of Vista ODC and Escaid 90 8

Table 2. Precision of Non-Polar Hydrocarbon Analyses: % Relative Standard Deviation of 9 Blind Duplicates 23

Table 3. Analysis of Standard Reference Material 24

Table 4. Precision of PAH Analyses (Six blind replicate analyses) 25

Table 5. Kovats Indices of Indicator Isoprenoids 28

Table 6. Blind Replicate and Reference Material Analyses of Ba in Sediments 34

Table 7. Summary of Vista ODC (equivalent) Concentrations in Post-Drilling Sediments 41

SUMMARY

The fate of low aromatic content base oil (Vista ODC), discharged from two artificial island exploratory well sites in the Beaufort Sea drilled by Esso Resources Canada Limited, was studied over a two year period. Oiled cuttings were discharged during the winter at both locations.

At Minuk I-53 a sacrificial beach island in 14 m of water, base oil could not be detected in surface sediments outside of an extensive area of grounded ice rubble surrounding the island immediately after drilling prior to ice break-up. Vista oil was widely dispersed in surface sediments at the end of the following open water season as delineated by a distinctive signature of low molecular weight isoprenoids in the GC trace. Most of the oil was dispersed around the south side of the island from the discharge point on the west side and thence in an easterly direction coinciding with the direction of net current flow in the area. Base oil could be be reliably quantified more than 700 m to the east of the island. The maximum concentration of Vista ODC (defined in terms of the sum of 10 low molecular weight isoprenoid peaks in the GC trace of Vista) in all samples collected was more than 4000 ug/g at a location 350 m to the southeast of the island centre.

Dispersal of oil-based muds appears to be enhanced by the presence of grounded ice rubble near a sacrificial beach island. Grounded ice restricts dispersion in the winter but can carry oiled cuttings long distances from the island after ice break-up. Less than 12% of the oil discharged at Minuk could be accounted for on the basis of the distribution of oil in surface sediments within 1 km of the island centre at the end of one open water season following the discharge. It is speculated that most of the oil that has been lost was either buried as a result of erosion of the island or was carried beyond the limits of the study area, likely via ice scour and ice transport.

Dispersion was more restricted at Kaubvik I-43, a caisson retained island in 19 m of water. Oiled cuttings were dispersed in an east-west orientation from the discharge point on the south side of the island. Highest (2000 ug/g) concentrations were to the west in the direction of net residual current flow with quantifiable base oil present more than 400 m in that direction. The maximum concentration of Vista observed was 2000 ug/g. However, less than 2% of the oil discharged at Kaubvik was present in surficial sediments on the basis of contour plots of surface sediment concentrations. It is not known whether the remaining oil is associated with a cuttings pile on

the berm slope or whether it was carried away with drifting ice during the early winter. Assuming that the oil is associated with an unsampled cuttings pile, the fate of oiled cuttings discharged from a caisson retained island appears to be governed mainly by currents and in this respect is more typical of conventional drilling platforms in more temperate seas.

RÉSUMÉ

Le devenir de l'huile de base à faible teneur en aromatiques (Vista ODC), déversée aux emplacements de deux îles artificielles avec puits de prospection forés en mer de Beaufort par la Esso Ressources Canada Limitée, a été étudié pendant une période de deux ans. Des déblais souillés d'huile ont été déversés pendant l'hiver aux deux endroits.

À l'île Minuk I-53, une île de sable sacrificielle construite par 14 m de profondeur, la présence d'huile de base n'a pu être détectée, dans les sédiments de surface à l'extérieur d'une zone étendue de moellons de glace échoués entourant l'île, immédiatement après les forages antérieurs à la débâcle. De l'huile Vista était très dispersée dans les sédiments de surface à la fin de la saison d'eau libre suivante, comme l'indiquait la signature distinctive des isoprénoïdes de faible poids moléculaire sur le chromatogramme CG. L'huile était en majeure partie dispersée autour de côté sud de l'île depuis le point de déversement situé du côté ouest en direction est, direction coïncidant avec celle de l'écoulement net du courant dans le secteur. L'huile de base pouvait être quantifiée de manière faible à plus de 900 m au sud est de l'île. La concentration maximale de Vista ODC (définie en termes de la somme de 10 pics correspondant à des isoprénoïdes de faible poids moléculaire sur le chromatogramme CG pour l'huile Vista) pour l'ensemble des échantillons recueillis s'élevait à 4000 ug/g et était relevée à 350 m au sud-est du centre de l'île.

La dispersion des boues à base d'huile semble avoir été favorisée par la présence de moellons de glace échoués près de l'île de sable sacrificielle. La glace échouée limite la dispersion pendant l'hiver, mais peut transporter sur de grandes distances les déblais souillés d'huile après la débâcle. La distribution de l'huile observée dans les sédiments de surface à moins de 1 km du centre de l'île Minuk à la fin d'une saison d'eau libre après le déversement ne permet de retracer que moins de 12 % de l'huile déversée. Il est supposé que la plus grande partie de l'huile perdue a été soit enfouie suite à l'érosion de l'île, soit emportée au-delà des limites de la zone à l'étude, vraisemblablement par raclage et transport par les glaces.

La dispersion a été plus confinée à l'île Kaubvik I-43, une île retenue par caisson construite par une profondeur de 19 m. Les déblais souillés ont été dispersés dans l'axe est-ouest depuis le point de déversement situé du côté sud de l'île. Les concentrations les plus élevées ont été relevées à l'est, dans la direction du courant résiduel net, l'huile de base étant quantifiable jusqu'à plus de 400 m dans cette direction. La con-

centration maximal d'huile Vista observée s'élevait à 2000 ug/g. Toutefois, moins de 2 % de l'huile déversée à l'île Kaubvik se retrouvait dans les sédiments de surface d'après les tracés en courbes des concentrations dans les sédiments de surface. On ne sait pas si le reste de l'huile est associé à un tas de déblais sur la risberme ou si elle a été emportée avec la glace en dérive pendant le début de l'hiver. En supposant que la plus grande partie de l'huile déversée est associée à un tas de déblais non échantillonné, le devenir des déblais de forage souillés d'huile déversés dequis une île retenue par caisson semble dépendre principalement des courants et serait à cet égard plus caractéristique de celui des déblais de plates-formes de forage classiques dans des mers plus tempérées.

INTRODUCTION

Oil-based muds (OBM) are drilling muds in which oil is the continuous phase. The main advantages of oil-based mud systems over water-based mud systems include: (1) improved hole stabilization particularly during the drilling of deviated wells; (2) increased protection of water-sensitive oil formations; (3) higher lubricity to ease release of the drill stem and prevent differential sticking; and (4) vast improvement of scaling and corrosion problems (Rogers 1974; Browson and Peden 1983; Lepine 1984). Diesel oil was originally favoured as the continuous phase of oil-based muds because it was readily available and inexpensive. In recent years, however, highly refined mineral oils such as naphthenic and paraffinic oils (the so-called low toxicity or alternative base oils) have replaced diesel because of their lower aromatic content and higher flash points.

Well cuttings become contaminated with drilling mud during the drilling process. Treatment of oiled cuttings by mechanical means including washing does not remove all the adhering drilling mud. Consequently, the discharge of drill cuttings will introduce some amount of petroleum hydrocarbons from the base oil to the marine environment. Based on information provided in Thomas *et al.* (1983), up to 25 percent (wt/wt) of the mud cuttings mixture may be petroleum hydrocarbons derived from oil-based drilling fluids for untreated diesel cuttings, 15 percent for treated diesel cuttings, and 5-10 percent for alternative base oil-based cuttings.

SUMMARY OF THE USE OF OIL-BASED MUDS IN THE BEAUFORT SEA

Low toxicity oil-based drilling muds have been used to drill four wells in the Beaufort Sea (Johancsik and Grieve 1987a). The first, Nipterk L-19A, was drilled during the spring of 1985 using Esso DMO-75 as the base oil. This well was a 55° directional well; oil-based mud was used because it offered a solution to directional drilling in a formation where severe hole problems and stuck pipe had been encountered earlier (Nipterk L-19). Use of the oil-based mud at Nipterk L-19A was very successful; in addition to eliminating hole problems, more than a doubling of the average penetration rate was achieved. Because the DMO-75 base oil contained an aromatic hydrocarbon content of 27%, ocean disposal of Nipterk drill cuttings was prohibited. Consequently, the cuttings were transported to shore and incinerated at

Tuktoyaktuk. They had an overall oil retention of 23.7 g oil per 100 g drill solids. During late 1985, oil-based muds were used to drill wells at Adgo G-24 and Minuk I-53. The fourth well to employ oil-based muds was drilled in late 1986 at Kaubvik I-43. The latter two wells were the focus of this study.

Adgo G-24 was a 60° directional delineation well in the Adgo field. Vista ODC was used as the base oil. Although this base oil contained acceptably low concentrations of aromatic hydrocarbons for marine disposal, the cuttings were incinerated to avoid discharge to the shallow nearshore environment where Adgo G-24 was situated. The well was drilled successfully to a total depth of 3087 metres.

At Minuk I-53, a combination of Vista ODC and DMO-75 up to a total aromatic content of 5% was used as the base oil to drill the portion of the well from 1000 to 3366 m total depth. Overall oil retention on the cuttings for the well was 13.6 g per 100 g dry solids. The cuttings were discharged to the ocean. At Kaubvik I-43, a mixture of Vista ODC and Escaid 90 was used for the interval between 984 m and 3323 m total depth. Oil retention on cuttings at this well was 14.95 g per 100 g dry solids. The cuttings were discharged overboard in ice-covered waters.

ENVIRONMENTAL EFFECTS ASSOCIATED WITH THE MARINE DISPOSAL OF OIL-BASED MUD CONTAMINATED DRILL CUTTINGS IN THE NORTH SEA

Historically, most drilling in the North Sea has involved use of water-based muds. Diesel oil gradually replaced water as the base fluid and in 1981, 36% of the 212 wells drilled in the United Kingdom sector of the North Sea had at least one section or part of a section drilled with diesel-based muds (Addy *et al.* 1984). Over the years 1981-1983, the quantity of oil in drill muds and cuttings discharged from all offshore rigs and platforms operating in the North Sea in drill muds and cuttings increased from about 7500 tonnes to 17,500 tonnes. The UK sector accounted for 80-90% of the total discharges (14,000 to 15,750 tonnes). In 1983, Denmark discharged no diesel oil, while 24% of the Netherlands', less than 50% of the UK's and 60% of Norway's discharged oil was diesel (Anon. 1985). By 1985, low aromatic content refined oils with a lower acute toxicity replaced diesel oil entirely in offshore drilling in the UK sector of the North Sea.

Numerous field studies have been conducted to determine the level of environmental disturbance resulting from North Sea drilling activities using diesel OBM and "low-tox" alternative oil-based mud (ABM). The results of these investigations have been discussed by Grahl-Nielson *et al.* (1980), Addy *et al.* (1983), Addy *et al.* (1984), Davies *et al.* (1984), Poley and Wilkinson (1983), and Hanam *et al.* (1987). The general conclusions of these studies are:

1. Cuttings contaminated with diesel OBM have a restricted environmental impact in time and areal extent. For bottom sediments, field observations indicate that three distinct zones of effect can be distinguished. Zone 1 extends from the production platform to approximately 500 m. Within this zone, the benthic community is impoverished, anaerobic conditions prevail in the surficial sediments and sediment hydrocarbon concentrations exceed 1000 times local background. Zone 2 (200 - 2000m) is a transition zone in terms of benthic diversity and community structure. Hydrocarbon concentrations are typically 10 - 700 times local background and aerobic conditions exist in the sediments. Zone 3 (800 - 4000 m) is characterized by hydrocarbon levels 1 - 10 times local background. No benthic community effects are evident within Zone 3.

2. The change to mineral oil-based muds appears to have had no influence on the nature of ecological effects described above in 1. The areal extent is the same and the main effects on the benthic environment are smothering of biota and organic enrichment.

REGULATORY GUIDELINES FOR THE USE OF OIL-BASED DRILLING FLUIDS ON CANADA LANDS

The use of oil-based drilling fluids on Canada Lands is governed by "Guidelines for the Use of Oil-based Fluids (COGLA 1985) and administered by the Canada Oil and Gas Lands Administration. The critical environmental aspects of the Guidelines are:

1. Base Oil: The Guidelines suggest that the total aromatic hydrocarbon content of the base-oil should not exceed 5% and that the polycyclic aromatic

hydrocarbon content should be as low as possible. Higher molecular weight polycyclic aromatic hydrocarbons (4 - 7 ring aromatics), in particular should not be present in the base oil. The base oil should be non-acutely toxic in a standard toxicity test using rainbow trout fingerlings, in which exposure is for 96 hours to the 100% water-soluble fraction of the base oil.

2. Oil Retention on Cuttings: Oil retention targets are 20 g oil per 100 g dry solids on a well average basis, with the maximum individual reading not to exceed 30 g oil per 100 g dry solids. Oil retention is measured by the standard retort test.

The Guidelines for approved oil-based mud formulations permit disposal of oil-contaminated drill cuttings directly to the ocean. Provision is made, however, to modify the guidelines to accommodate circumstances where there is known environmental sensitivity or concern (e.g., water depths < 20 m and critical biological habitats such as migration corridors, feeding areas, rearing areas, etc.).

STUDY RATIONALE AND OBJECTIVES

(a) Study Rationale

While experience in the North Sea and the two wells on the east coast offers much relevant information, there are several aspects of drilling in the Beaufort which limit the use of data collected in more temperate regions. Water depths are generally less than 35 m in the areas where major oil discoveries have been made, the region is ice covered for up to 9 months of the year, the bottom subject to ice scour, and artificial islands and berm supported caissons are used as drilling platforms. In addition, productivity is lower than in more temperate seas and the habitat possibly more sensitive to the effects of discharged wastes and site disruption.

This study was carried out to address the fate of oil-contaminated cuttings discharged from two well sites in the Beaufort Sea. The two wells, Minuk I-53 and Kaubvik I-43, were drilled by Esso Resources Canada Limited in the winters of 1985-86 and 1986-87 respectively. Minuk I-53 was drilled from a sacrificial beach island in

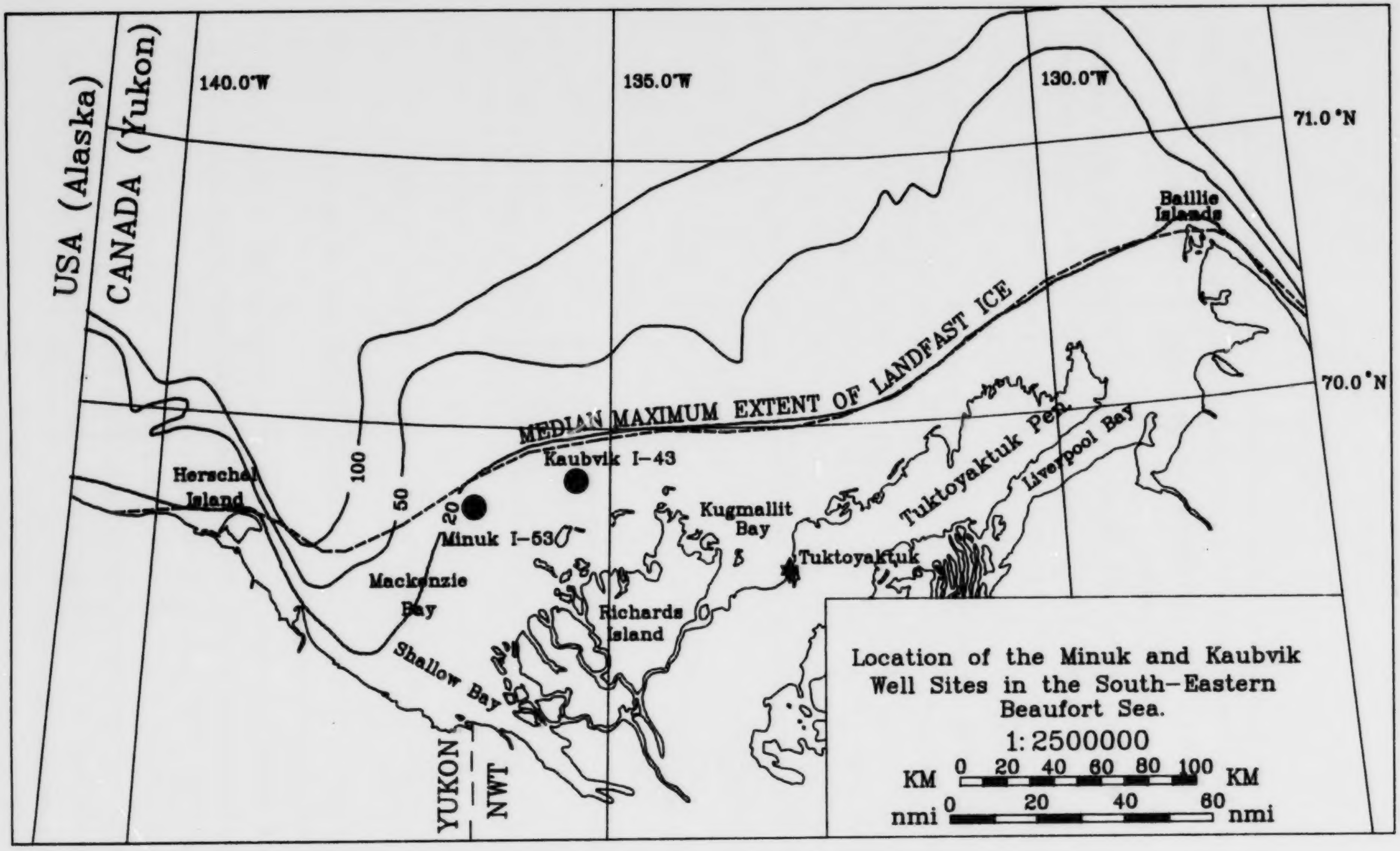
140.0°W
135.0°W
130.0°W
71.0°N
70.0°N
USA (Alaska)
CANADA (Yukon)
Herschel Island
100
50
20
MEDIAN MAXIMUM EXTENT OF LANDFAST ICE
Kaubvik I-43
Minuk I-53
Kugmallit Bay
Tuktoyaktuk
Tuktoyaktuk Pen.
Liverpool Bay
Baillie Islands
Mackenzie Bay
Shallow Bay
Richards Island
YUKON
NWT
Location of the Minuk and Kaubvik Well Sites in the South-Eastern Beaufort Sea.
1: 2500000
KM 0 20 40 60 80 100 KM
nmi 0 20 40 60 nmi

Figure 1. Location of Minuk I-53 and Kaubvik I-43 in the south-eastern Beaufort Sea.

14 m of water and Kaubvik I-43 drilled from a caisson on a sub-sea berm in 19 m of water. Both locations are near the outer edge of the average maximum extent of landfast ice (Figure 1). The water depths and island types are representative of most offshore wells drilled in the Beaufort.

Cross-sectional views of a typical sacrificial beach island and caisson supported on a sub-sea berm island as used at Minuk and Kaubvik respectively, are shown in Figure 2. Discharge of treated cuttings from a sacrificial beach island is into the shallow water of the upper island slope. Although water depth is usually greater at a caisson-retained island, in both instances cuttings will accumulate on one side of the structure and cannot be dispersed in any direction freely. Dispersion from a sacrificial beach island will be very dependent on wave action in open water as well as ice scour. Once abandoned, these types of islands quickly erode (EBA Engineering, 1984). Because of the greater depth, wave action will be less of a factor and local currents more important in dispersal of oiled cuttings from a caisson retained island.

b) Objectives

The specific objectives of this study were:

1) to monitor the concentration of base oil in the vicinity of the well locations; and

2) to determine the areal extent of cuttings at both well locations.

These two objectives were to be based on measurements made on the completion of drilling and following one open water season.

The Kaubvik well was to be drilled in the summer of 1985, but was delayed until the fall/early winter of 1986/87. The Minuk island and rig were damaged by a storm in September 1985, delaying spudding of that well until the early winter of 1985. Drilling was completed in April 1986. As a result of these changes in drilling schedule, only two sampling trips were made to the Kaubvik site; pre-drilling and sampling at the beginning of the open water season following well completion just prior to the removal of the caisson.

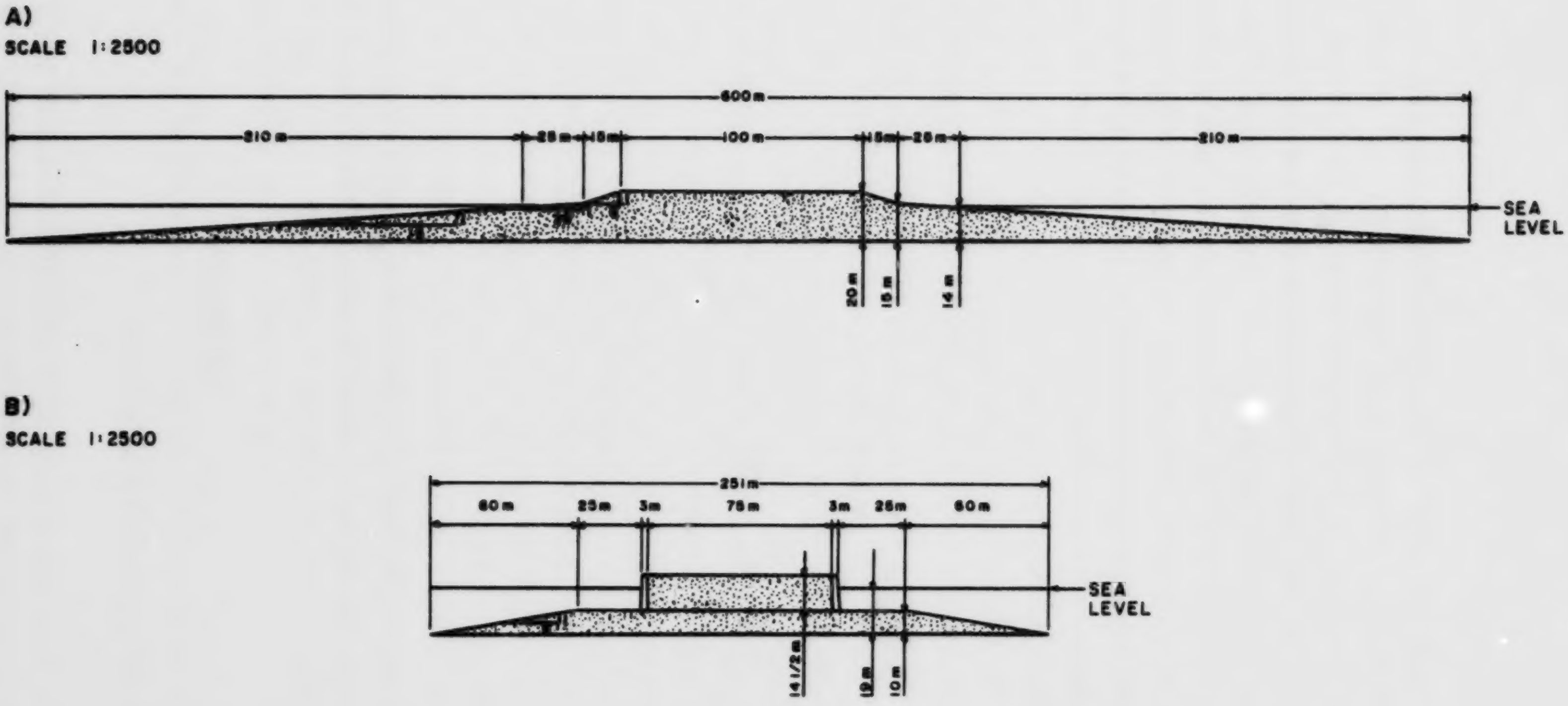
A)
SCALE 1:2500
600m
210m
25m
15m
100m
15m
25m
210m
SEA LEVEL
20m
15m
14m
B)
SCALE 1:2500
251m
60m
25m
3m
75m
3m
25m
60m
SEA LEVEL
14 1/2m
19m
10m

Figure 2. Cross-section profile: a) sacrificial beach island, Minuk I-53, and b) caisson retained island, Kaubvik I-43.

Approximately 740 m^3 of treated drill cuttings were discharged at Minuk between November, 1985 and April 1986 and 342 m^3 of cuttings discharged at Kaubvik in November and December 1986. A total of 278 tonnes of oil was discharged along with 1249 tonnes of barite at Minuk. At Kaubvik, a total of 143 tonnes of base oil were discharged with 332 tonnes of barite. Vista ODC was used at Minuk and Vista ODC supplemented with smaller amounts of a second base oil, Escaid 90, used at Kaubvik. Both Vista ODC and Escaid 90 are paraffinic, naphthenic base oils with low (< 1%) aromatic contents. A summary of their characteristics is given in Table 1.

Table 1.

Physical Characteristics of Vista ODC and Escaid 90 (from Johancsik and Grieve, 1987b)

Product	Viscosity cSt	Pour Point °C	Density kg/m^3	Aromatics %	100 % WSF LC 50 toxicity
Vista ODC	1.8	- 59	0.805	0.2	non-toxic
Escaid 90	1.24	- 50	0.792	0.5	non-toxic

Vista ODC was also the base oil used in the study of the fate of OBM discharged at two well sites on the east coast offshore Nova Scotia (Yunker and Drinnan, 1987).

METHODS

SAMPLING DESIGN AND RATIONALE

A stratified random sampling design was used at both well locations as a basis for selecting sampling sites. Both systematic and stratified random sampling designs were considered; a stratified random design was selected as being the most appropriate given the allowable number of sites per location (~25) and the nature of the drilling platforms.

(a) Definition of the Impact and Control Areas

From empirical studies, concentrations of base oil should decrease exponentially with increasing distance from source. The distribution of oiled cuttings was not expected to be radially symmetric since the cuttings were to be discharged on one side of the island. The highest concentrations were expected to occur on the same side of the island as the discharge point. Although residual currents could cause left-right asymmetry in dispersion, initially this asymmetry was assumed to be slight on the basis of measured frequency distributions of water currents in the general area of the Beaufort occupied by the two drilling sites.

The two sites, Kaubvik and Minuk, were expected to produce different distributions on the basis of water depth, mode of discharge and island construction. At Kaubvik, the discharged material was expected to enter the water directly and was expected to be dispersed by water currents, whereas at Minuk the discharge was to be inside the ice rubble field which would be expected to retard dispersal. Thus, it was expected that the distribution of oiled cuttings at Minuk should be more localized. Based on modelling experience and hydrocarbon distributions around North Sea oil rigs (Thomas *et al.*, 1983) and a field study of trace metal distribution around Issungnak, (Erickson *et al.*, 1983), the outer limits of the expected zones of impact at Minuk and Kaubvik were set at radial distances of 1 km and 2 km respectively, from the island centres. At Minuk, the estimated extent of the ice rubble field determined the radius of the innermost circle within which samples could not be taken; at Kaubvik, the berm was defined as an area or innermost circle where samples could not likely be taken due to the coarse nature of the substrate and the expected anchor lines and ship/barge traffic. It was also assumed that:

1) the cuttings would be discharged from a known point on one side of the island, and

2) that the processes causing dispersion would be more or less isotropic, e.g., residual water currents evenly distributed angularly near the point of discharge.

The impact areas are depicted in Figure 3. Within each impact area, five sub-areas (strata) were defined according to expected probability of impact. Three angular zones were defined:

Zone	Description
1	a high probability of impact area, 120° centered at the discharge pipe on the same side of the island,
2	an intermediate zone, 60° section either side of and adjacent to the high probability zone, and
3	a low probability zone, 120° section, on the opposite side of the island from the high probability zone.

Zone 1 was further subdivided into 3 radial strata on the basis of distance from the discharge. Previous experience suggests that most of the cuttings will be found within 500 m of the discharge point. For both islands, the discharge pipe was expected to be at 270° (true) from the island centre. The expected probabilities of an observable impact occurring in the strata followed the order, average of (1,2,3) > 4 > 5 and 1 > 2 > 3.

(b) Number and Allocation of Samples to the Impact and Control Areas

A total of 29 sampling sites were allocated per well location based on the expected number of sampling trips and budget. The sampling sites were chosen randomly within each stratum by dividing them into sub-strata (10° arcs, 50 m concentric circles), assigning numbers to the substrata and randomly selecting the numbers. The procedure of randomly selecting the sampling locations within the strata was performed before each sampling time. Additional samples were taken from locations randomly chosen within two reference zones (zones beyond the outer radius), one for each drill site. The reference zones at each site were 500 m diameter circles centered 750 m outside the study area to the east in water of similar depth and with a relatively flat bottom (no borrow pits; trenches).

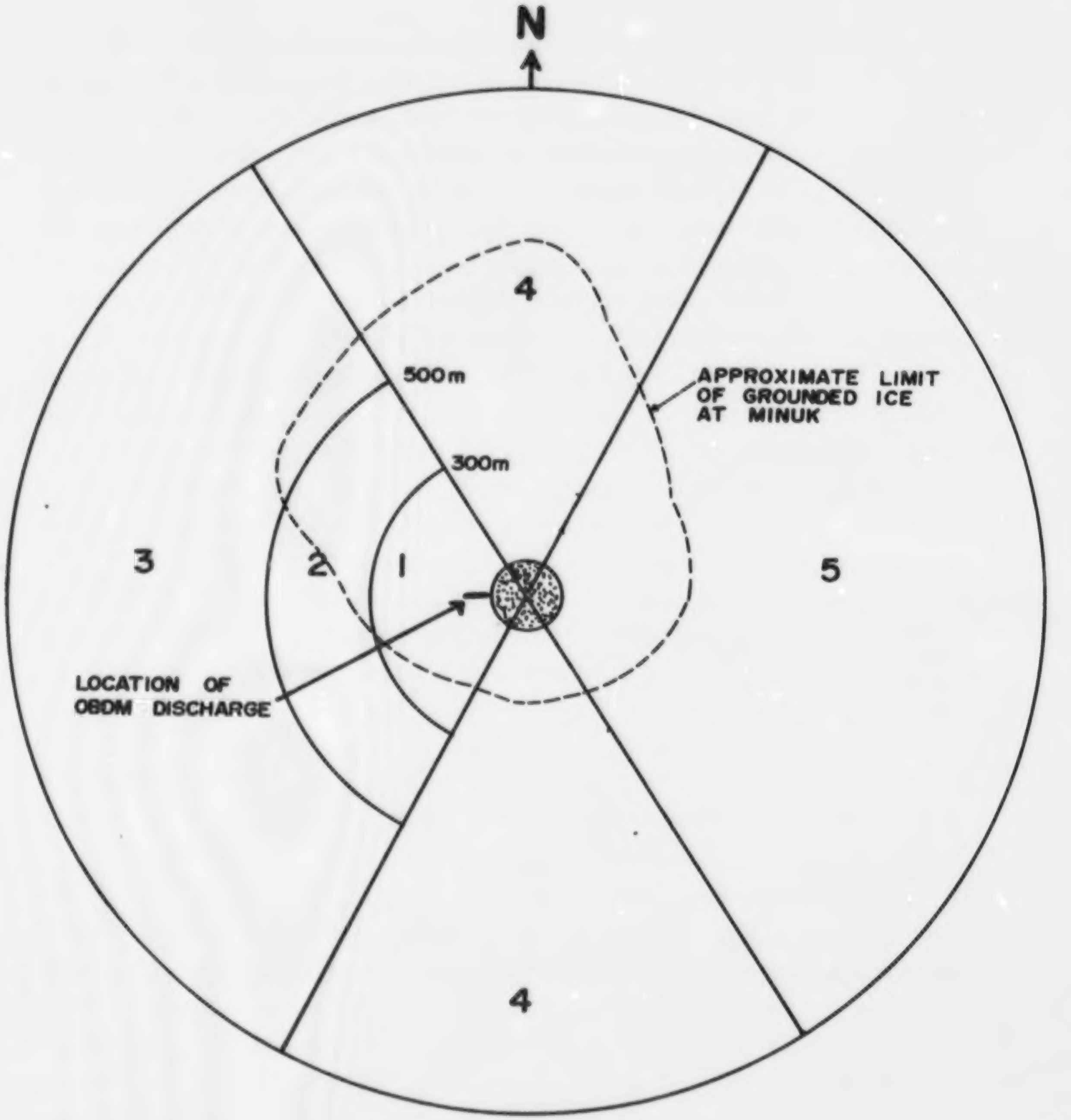
N
4
500m
300m
APPROXIMATE LIMIT OF GROUNDED ICE AT MINUK
3
2
1
5
LOCATION OF OBDM DISCHARGE
4

Figure 3. Sampling strata and outline of ice rubble boundary at the Minuk Island, winter 1986.

Normally in stratified random sampling, samples are allocated to the strata in proportion to the areas and to the internal standard deviations. In the present case, it was desirable to be able to detect an impact if it occurs over a more or less restricted area. For example, the impact may be confined to stratum 1 or it may extend over several strata. The objective was not just the mean concentration over the entire 1 or 2 km circle, but also to estimate the mean concentrations over sub regions such that the overall chance of detecting an impact was increased. This was achieved by allocating approximately equal numbers of samples to each of the five strata so that the areal density of sampling sites was highest in the stratum of highest probability of impact. The strata were viewed as discrete entities having different estimated probabilities of impact. The number of samples taken from each stratum plus the number of control samples is tabulated below (based on a maximum of 29 sites per location).

	No. of Samples	
Stratum No.	**Minuk**	**Kaubvik**
1	5	5
2	6	6
3	4	4
4	8	8
5	3	3
Reference	3	3

Additional samples (randomly selected from each strata) were taken but not analyzed.

(c) Study Variables

Non-polar hydrocarbons in surface sediments were the basis for the measurement of base oil associated with oiled-cuttings. Aromatic hydrocarbons (PAH) were analyzed in selected samples despite the low aromatic content of the base oils on the basis of East Coast results. Yunker and Dunnan (1987) had found an elevation in PAH concentrations near East Coast exploratory wells which they attributed to the presence of formation oils.

It has been well documented from previous Beaufort Sea sediment analyses (Hoff and Thomas, 1986) that background hydrocarbon concentrations vary with sediment particle size. It was therefore necessary to define the sediment particle size (in terms of % clay and silt). Waste cuttings also contain large quantities of barite and the Ba content of sediments was also measured as a complimentary indicator of the presence of drilling mud in the sediment.

(d) Other Sampling Strategies

A strategy involving the preparation of composition samples was employed to reduce the sampling variance. Three replicate grabs were taken at each sampling site and 3 subsamples, taken from the top 1 cm of sediment of each grab, combined. From the results of Piotrowicz *et al.* (1981) the composite samples should be an unbiased estimate of the mean of the three replicates. Analysis of a composited sample would thus substantially reduce the sampling variance for a little extra effort. The variance of replicate grabs within sites was not measured because it was not used in subsequent analysis.

SAMPLING

The sampling schedule in this study was revised several times as a result of alterations in drilling schedules. The Kaubvik I-43 well, originally planned for the summer of 1985 was not spudded until the fall of 1986 just prior to freeze-up. The Minuk island and drilling rig suffered severe damage in a storm in September 1985 which delayed spudding of that well until after freeze-up in 1985. It is estimated that approximately 2300 tonnes of barite and 338,000 litres of diesel fuel were lost around the island as a result of the damage to the island and storage tanks. Loss of this material as well as erosion and large scale alterations to the island necessitated repeat background sampling. The following is a summary of the sampling actually completed:

Sampling Trip	Dates	Description	Sample Series
1	August 29 - Sept. 4/85	Pre-drilling sample collection	
		at Minuk	1
		at Kaubvik	2
2	Sept. 29 - Oct. 11/85	Repeat of pre-drilling sample collection at Minuk	3
3	April 18 - 27/86	Post-drilling sampling through the ice at Minuk	4
4	Sept. 20 - 22/86	Follow-up sampling at Minuk; additional back-ground samples at Kaubvik and deployment of sediment traps	5
5	August 1 - 4/87	Post-drilling sampling at Kaubvik	6

Samples were assigned a series number corresponding to the sampling trip and the island location as indicated above. These terms (series 1 through 6) are used in subsequent discussions of the data.

In the first two sampling periods, series 1, 2, and 3 samples were collected at randomly chosen sites as described previously. On subsequent sampling trips, **modifications to the basic stratified random sampling plan were made.** On the third trip, no sampling was possible within the extensive ice rubble field around the island. Most of strata 1 and much of strata 2 and parts of strata 3, 4 and 5 were not accessible. Sample locations were modified to take this into account. In addition, a series of samples was collected in a systematic fashion at the outer edge of of the rubble field at approximate 30 degree intervals between 030 and 240° (true) from the island centre. The approximate extent of the rubble field and station locations are shown in figure 3.

On the fourth sampling trip (open water follow-up sampling at Minuk) a set of 10 locations were sampled in addition to the randomly selected sites. These were chosen in a systematic fashion at a nominal distance of 150 m from island centre progressing around the island at 30 degree intervals through strata 1 and 4 (south) and 45 degree intervals through strata 5 and 4 (north). On the final sampling trip to Kaubvik (trip 5), an additional 8 sites were selected around the caisson at nominal distance of 250-300 m from the caisson centre at 45 degree intervals. On the final sampling trip, barges and ships around the caisson prevented sampling at certain locations in strata 1. It had been assumed that the discharge pipe from Kaubvik would discharge to the west and strata had been aligned on this basis in the background sampling (series 2). Cuttings were however, discharged due south and the sampling locations were modified therefore so that strata 1 - 3 were centred at 180° (true) on the final sampling trip.

Surface samples were collected with a modified Ponar grab with a 0.06 m^2 bite. The grab sampler was deployed with an aluminum hand winch and davit welded to the deck of the support vessels. Three separate grabs were taken at each sampling site and sub-samples from each combined in a single 250 ml hydrocarbon clean glass storage jar. The sampler was equipped with hinged stainless steel doors allowing access to the surface of the sample after the grab had been retrieved. The upper 2 cm of sediment were skimmed from the surface of the grab with a cleaned stainless steel scoop. In April, 1986, the grab sampler was deployed through 60 cm diameter holes in the ice made with a portable hot water ice melter. In September, 1986, seven sample locations 200m or less from the Minuk island centre were not accessible by boat and were sampled by diver. Diver collected samples were taken by scooping the top 2 cm of sediment into a 150 mL sampling jar from three locations within 10 m of the target site. The sample jar was recapped before returning to the surface.

Core sampling was attempted at Minuk on the fourth sampling trip close to the island in an attempt to see if any drilling muds were buried and detectable in deeper portions of the sediment. Coring was unsuccessful as the sediments were exclusively sand. Three gravity cores were taken on the final sampling trip at Kaubvik from just beyond the berm. Corers consisted of a 10 x 50 cm acylic core tube with stainless steel cutting head on a lead weighted, aluminum core head. The corer was lowered to within 3m of the bottom and then allowed to free fall. Cores were successfully collected at a distance of 380 m; 090, 180 and 270 degrees from the island centre. Cores were extruded with an aluminum foil covered plunger onto a cleaned aluminum foil covered surface, sectioned into subsamples 2-6 cm in length then transferred to glass storage jars as for grab samples.

All sediment samples were stored cool until returned to the laboratory where they were homogenized and then frozen until analysis (1 - 3 months). In April 1986 (Series 4) samples were frozen immediately after collection and not thawed until analyzed.

Samples for Ba and particle size analysis were taken from each grab or core sample after samples were taken for hydrocarbon analysis. Approximately 50 g of wet sediment from the upper few cm was skimmed off with a scoop and placed in a plastic 'Whirl-Pak' bag. Samples were stored at room temperature.

(a) Positioning

Several different methods of positioning were used. Supply vessels used to sample on trips 1, 2, and 4 were equipped with a Syledis SR3 positioning system with a HP 9836 computer and display. The positioning system recorded the location of the sampling davit at the time of grab impact and positions are believed accurate to within 10 m. On the final sampling trip, positioning was via radar range and bearing to the caisson centre. Positioning accuracy under these conditions is believed to be within 50 m close to the caisson and to within 200 m at 2 km from the caisson. Positions in April, 1986 (trip 3) were surveyed by triangulation from reference points on the island with range determined to within 5 m. Sampling was complicated on trips 1, 2 and 4 because of the fast drift rate of the vessel. In all cases, the vessel was positioned so as to drift over the station. When within a 50 m radius of the target area, the grab was deployed. On the final sampling trip, the Arctic Nanook was able to maintain its position over the target area through the use of bow thrusters.

(b) Sediment Traps

Sediment traps were deployed at each site prior to the start of drilling. Traps were deployed at three sites at each island on the same side as the discharge pipe and off the island or berm slope. Each mooring consisted of two 10 cm diameter x 70 cm long PVC cylinders with a glass collection cup at the bottom suspended approximately 3 - 4 m above the sediment. Only one trap mooring from the Kaubvik site was successfully recovered. Three trap clusters were deployed at Minuk on the first sampling trip but all were lost in the storm that damaged the island. Three more trap clusters were deployed at Minuk on the second trip prior to freeze-up. Two of the mooring locations were within the ice rubble field in April and could not be recovered. Attempts were made to recover the third trap by diver but no trace of the trap or mooring was found. Moorings were equipped with pingers with a range of at least 1 km but no signal from any of the pingers was detected. It is assumed that the traps were dragged off location by moving ice. Three trap clusters were deployed at Kaubvik just prior to freeze-up at the end of trip 4. These were deployed at a distance of 300 m and angles of 120, 180 and 210 degrees from the island centre (positions were restricted because of the location of equipment around at the island at the time of deployment). Recovery of the traps was attempted on the final trip in August, 1987. The traps at 120 and 210 degrees were located although no signal from the trap at 180 degrees was detected. The trap at 120 degrees was recovered but neither of the other traps was retrieved. The trap at 210 could not be grappled because of anchor lines and barges servicing and preparing to dismantle the caisson. After recovery, excess water was decanted from the glass collection jars at the bottom of each trap and stored as for sediment samples.

(c) Current Meters

Aanderaa RCM-4 current meters were deployed at Minuk during drilling at locations approximately 1 km due north and south of the island to obtain a current record during OBDM discharge. One meter was deployed at each site at depths of 6 - 7 m. Both meters were deployed initially on trip 1 on August 30 and were to have been recovered prior to freeze-up. On October 10, 1985 the instruments were checked as a result of the storm that had damaged the island. The north meter was damaged (rotor missing; vane bent) and no usable data obtained. Another meter was deployed at this location. The south meter was operating properly, the tape replaced and the meter redeloyed. The south meter was at a depth of 6.1 m for the initial period and 13 m over winter. Recovery of the meters was attempted by diver April 20-22, 1986. The north meter was not found and is presumed to have been dragged off position by ice. The south meter was recovered on April 21. The south meter had been moved about 75 m off location and was buried in the mud with only the vane and viny floats showing. This had evidently occurred shortly after deployment as only about a 2 week record was obtained.

HYDROCARBON ANALYSES

(a) Materials

Solvents used were distilled in glass, pesticide grade (hexane and pentane, Burdick and Jackson; methanol, dichloromethane and acetone; BDH Omnisolve). A solvent blank was determined for each new solvent bottle used and that bottle used only if free of interfering compounds.

Distilled water and potassium hydroxide solutions were extracted with pentane before use. Anhydrous sodium sulphate was cleaned by heating at 350°C for 24 h cooled in a stoppered flask and deactivated with 5% water by weight and allowed to stand 24 h before use. The silica gel was slurry packed in pentane into a 13 x 1.0 cm column, covered with a 1 cm layer of anhydrous sodium sulphate and flushed with 25 mL pentane before use.

Glassware and metal items were washed, rinsed with distilled water and baked overnight at 350°C in a forced air oven immediately before use. Non-bakable items were solvent rinsed (acetone and dichloromethane) before use.

Internal standards (5α-androstane, Aldrich; perdeuterated decane, hexatriacontane, naphthalene, anthracene, pyrene, chrysene, benzo(k)fluoranthene and perylene; Merck Sharp and Dohme) were used as received. The Vista low toxicity base oil was supplied by Esso Resources from Minuk and Escaid 90 base oil supplied by Esso Petroleum, Vancouver.

(b) Extraction Methods

The method used for the determination of hydrocarbons in sediments and drill cuttings is an adaptation of the method of Cretney *et al*. (1980) as used previously for the determination of low toxicity base oil in cuttings and marine organisms (Hutcheson *et al*., 1984). Since the Vista oil is relatively volatile (boiling range 188°C to 270°C, corresponding to nC10 to nC15) special consideration is to retain the volatile components during work up, primarily by the use of Kuderna-Danish solvent evaporators for solvent removal.

Sediments were stored frozen and prior to analysis were allowed to thaw at 40°C overnight, thoroughly mixed and subsampled for hydrocarbon analysis and dry weight determination.

A sediment subsample (20 - 30 g) was weighed into a 250 mL round bottom flask with 40 mL methanol, 4 g 50% aqueous potassium hydroxide and aliquots of internal standards for the nonpolar hydrocarbons (n-decane-d22, 5α-androstane, n-hexatriacontane-d74) and perdeuterated PAH (naphthalene, anthracene, pyrene, chrysene, benzo(k)fluoranthene, and perylene). The flask was initially mixed by swirling then the sample refluxed for 1 h. Water (40 mL) was added to hydrolyse esters and the sample refluxed for an additional 30 minutes. The cooled digest was serially extracted by shaking with pentane (3 x 60 mL) and the extracts decanted through a glass fibre filter (47 mm Whatman GF/C in a Millipore holder) into a 250 mL separatory funnel. The combined extracts were washed by back extraction with pre-extracted water (3 x 60 mL), dried over anhydrous sodium sulphate and taken down to 500 mL in a Kuderna-Danish concentrator. The concentrated extract was loaded onto a silica gel column (10 mL bed volume, 13 cm x 1.0 cm, 5% water deactivated, topped with a 1 cm layer of anhydrous sodium sulphate). Non-polar hydrocarbons were eluted with 25 mL pentane and the aromatics with 40 mL dichloromethane, and the fractions taken down to 100 mL by Kuderna-Danish for GC/FID and GC/MS/SIM analysis.

An additional subsample (5 g) was weighed into a 50 mL beaker and dried at 80°C for 24 h for dry weight determination.

(c) Instrumental Methods

Non-polar hydrocarbons were analysed using Hewlett-Packard 5830A/5840A gas chromatographs with flame ionisation detectors (FID) operated with the following instrumental conditions:

Column: 25 m x 0.22 mm BP-5 bonded phase fused silica column, (SGE).

Carrier:	Hydrogen at 14-18 psi, 1 mL/min nominal flow rate.
Injector:	Grob type, split/splitless, 250°C, splitless 1.0 μL injections, split resumed 1.0 min. after injection.
Detector:	FID at 300°C, hydrogen 50 mL/min, air 300 mL/min, nitrogen (make up) 30 mL/min.
Program:	Initial oven temperature 50°C, held for 1.0 min., oven heated at 10°C/min to 300°C and held for 10 min.

Peak areas were measured using the HP 5830/40 integrator and compounds were quantified relative to the primary internal standard 5α-androstane. Additional QC internal standards were present: perdeuterated n-C10 as a volatilisation check, and perdeuterated n-hexatriacontane as a high molecular weight marker and activity check.

An even n-alkane calibration standard was run at least once a day and relative response factors calculated relative to 5α-androstane.

Aromatic fractions were analysed on a Finnigan 9500/3200 gas chromatograph-mass spectrometer (GC/MS), with a Finnigan 6100 data system using the following conditions:

Column	30 m x 0.25 mm DB-5 bonded phase fused silica column (J.& W. Scientific)
Carrier Gas	helium
Injector Flow Rate	60 mL.min-1
Injector Pressure	17 psig

Column Flow	40 cm s-1
Split Ratio	40:1 (approximately)
Injector Temperature	260°C
Injection Sequence	splitless injection at room temperature, splitting resumed at 1 minute, 100°C at 2 minutes and 10°C min-1 at 6 minutes to 300°C and hold for 10 minutes. 0.5 mL injections.
Mass Spectrometer	electron impact source
Source Emission	0.50 mA
Electron Energy	40 eV
Operating Pressure	1 x 10-5 torr
Multiplier Voltage	2000 V (gain > 1×10^6)
Data Acquisition	data acquired in the "selected ion monitor" mode with one scan/sec; five clusters of four ions per run. Data archived on magnetic tape.

PAH and masses monitored were naphthalene (128), naphthalene-d_8 (136), C1 to C4 alkylated naphthalenes (142, 156, 170, 184), fluorene (166), dibenzothiophene (184), C1 to C2 alkylated dibenzenothiophenes (198 and 212), phenanthrene (178), anthracene (178), anthracene-d_{10} (188), fluoranthene and pyrene (202), pyrene-d_{10} (212), C1 to C4 alkylated phenanthrene/anthracene (192, 206, 220 and 234), benz(a)anthracene (228), chrysene (228), chrysene-d_{12} (240), benzofluoranthenes (b, k, j and a) (252), benzo(k)fluoranthene-d_{12} (264), benzo(e)pyrene (252), benzo(a)pyrene (252), perylene (252) and perylene-d_{12} (264).

(d) Quality Control and Quality Assurance

A comprehensive quality control program has been followed to maintain accuracy and precision for hydrocarbon analyses, which includes the following:

1) Procedural blanks run initially and regularly throughout the sample suite.

2) 10% of the samples analysed as blind replicates.

3) GC response calibration standards run daily and GC/MS calibrations run at the beginning and end of each working day. The relative response factors are required to be within prescribed limits before analytical data from that day is used.

4) Frequent duplicate GC injections to monitor instrumental variation.

5) Mass spectrometer resolution and response to a fragmentation standard required to meet U.S. EPA criteria (Eichelberger *et al.*, 1975).

The precision of non-polar hydrocarbon analyses was estimated by the results of blind replicate analyses of selected sediments. A total of 9 samples were analysed and the results are given for individual resolved components in Appendix E. The precision based on the pooled variance of the 9 samples expressed as the relative standard deviation was 21% for total non-polar hydrocarbons; 19% for the sum of the 10 Vista marker isoprenoids; and 22% for total n-alkanes (Table 2).

The accuracy of PAH analyses was monitored by the analysis of a certified reference material (U.S. National Bureau of Standards S.R.M. No. 1647) consisting of an acetonitrile solution of several PAH of interest at a certified concentration. Results are presented in Table 3. The precision of total PAH analyses based on the pooled variance of six blind replicate analyses was 11% (relative standard deviation) (Table 4).

Table 2.
Precision of Non-Polar Hydrocarbon Analyses: % Relative Standard Deviation of 9 Blind Duplicates
(See Appendix E)

	2-09	2-12	3-07	3-20	5-05	5-11	6-05	6-15	6-41	Mean Relative Standard Deviation %
nC10 d22							145.5	27.8	22.5	65
nC10	48.6	40.0	142.9	117.2	100.0	107.7	176.5	59.2	44.4	93
nC11	185.8	173.8	192.6	193.2	191.0	104.0	15.4	46.9	6.9	123
nC12	125.0	58.8	18.2	79.1	196.5	22.9	22.2	14.6	6.8	60
Norf (a)[1]	200.0	200.0	200.0	200.0	10.9	7.7	34.1	29.2	6.7	109
Norf (b)[1]	200.0	200.0	200.0	200.0	60.0	16.0	29.6	24.1	5.7	104
Norf (c)[1]	200.0	200.0	200.0	200.0	6.3	27.0	34.1	30.4	13.3	101
Norf (d)[1]	200.0	200.0	200.0	200.0	75.6	1.9	41.4	28.6	17.1	109
Norf (e)[1]	200.0	200.0	200.0	200.0	80.7	23.5	21.2	16.7	6.1	105
nC13	93.6	89.7	71.7	44.9	24.6	22.2	6.1	0.0	171.4	58
Farnesane	35.3	50.0	11.8	36.4	66.7	3.0	95.8	18.2	2.6	36
nC14	60.5	75.9	100.0	44.4	24.0	11.5	85.7	0.0	27.3	48
TMT[1]	27.3	44.4	73.3	45.2	33.3	42.4	62.5	0.0	14.0	38
nC15	17.7	49.5	67.9	10.5	23.4	20.8	30.8	13.3	26.7	29
nC16	16.5	39.4	40.0	18.2	42.4	2.2	4.1	12.5	16.0	21
Norpristane	4.5	7.6	36.5	43.9	23.5	11.5	53.4	28.1	32.8	27
nC17	27.5	10.5	41.1	12.8	106.2	13.7	30.1	14.2	42.6	33
Pristane	16.3	11.2	8.7	32.8	8.0	13.3	28.6	7.7	30.4	17
nC18	17.4	1.1	3.3	62.2	88.5	48.6	23.1	27.5	11.8	31
Phytane	0.0	14.9	4.9	53.3	85.7	14.2	8.4	16.7	22.2	24
nC19	21.6	16.7	13.3	31.3	88.4	16.2	38.7	9.1	35.3	30
nC20	2.9	40.0	38.7	71.1	43.9	26.7	200.0	33.3	0.0	51
nC21	37.0	42.9	0.0	63.5	82.4	8.7	39.0	6.7	6.1	32
nC22	6.2	17.9	0.0	72.0	76.9	11.3	50.0	0.0	1.4	28
nC23	21.0	0.0	3.0	73.2	88.	44.4	46.2	16.9	26.7	36
nC24	0.0	5.1	9.1	74.1	46.8	25.6	36.4	5.1	37.6	27
nC25	5.1	16.7	3.2	81.5	75.4	25.3	42.6	14.3	48.3	35
nC26	6.3	20.7	.7	108.3	5.1	34.1	51.9	15.4	65.8	35
nC27	12.3	28.6	14.	74.4	81.7	24.6	36.8	25.4	58.8	40
nC28	19.7	43.8	34.5	144.2	44.4	115.2	100.0	15.4	73.9	66
nC29	43.2	8.0	23.7	107.3	41.4	115.2	77.4	50.0	55.3	58
nC30	40.0	22.2	46.2	134.2	140.7	117.6	0.0	81.9	71.2	73
nC31	21.3	31.2	45.2	127.3	23.3	117.6	154.7	73.2	78.4	75
nC32	74.3	32.6	112.6	171.0	142.9	111.1	0.0	115.2	75.4	93
nC33	52.6	52.4	16.8	153.8	144.8	111.1	0.0	17.1	76.2	69
nC34	24.2	81.1	8.7	141.7	146.7	113.5	15.4	5.1	76.9	68
nC35	18.9	40.0	150.0	125.6	137.5	117.9	15.4	10.5	75.4	77
nC36	49.4	8.0	46.2	100.0	141.2	112.2	0.0	21.1	74.0	61
nC37	1.9	90.0	46.2	46.2	141.2	112.2				81
nC38	8.7	0.0	46.2	46.2	141.2	112.2				72
Total NPH	11.0	6.9	0.0	70.2	27.1	7.9	40.0	19.2	6.4	21
Isoprenoid	3.3	19.8	13.2	40.4	22.6	10.	45.7	18.4	0.2	19
Total n-alkane	13.3	5.2	1.7	74.8	38.1	1.8	36.0	19.6	10.5	22
nC11-nC13	149.2	98.0	113.3	125.8	74.8	9.4	14.1	29.3	9.8	69

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[1] See Table 5 for retention indices.

Table 3.

Analysis of Standard Reference Material (NBS SRM 1647, PAH Dissolved in Acetonitrile) $\mu g \cdot mL^{-1}$

Compound	Seakem Values(a)	Certified Values(b)
naphthalene	16.6 ± 0.7	22.5 ± 0.2
acenaphthylene	19.1 ± 1.7	19.1 ± 0.2
acenaphthene	13.7 ± 1.3	21.0 ± 0.4
fluorene	5.2 ± 0.1	4.9 ± 0.1
phenanthrene	3.6 ± 0.2	5.1 ± 0.1
anthracene	4.1 ± 0.6	3.3 ± 0.1
fluoranthene	8.6 ± 0.8	10.1 ± 0.2
pyrene	7.4 ± 0.3	9.8 ± 0.1
benz(a)anthracene and chrysene	8.9 ± 0.5	9.7 ± 0.2
benzofluoranthenes	6.9 ± 0.4	10.1 ± 0.2
benzo(a)pyrene	3.1 ± 0.3	5.3 ± 0.1

(a) uncertainty calculated from duplicate analysis
(b) stated uncertainity of standard reference material

Table 4.

Precision of PAH Analyses
(Six Blind Replicate Analyses)

	Pooled Standard Deviation (S)[a]	Pooled Relative Standard Deviation (% rsd)	Mean Relative Standard Deviation (rsd)
Naphthalene	5.6	(15%)	6
Cl naphthalenes	20	(13%)	10
fluorene	68	(38%)	19
C2 naphthalene	68	(20%)	27
C3 naphthalenes	16	(5%)	6
C4 naphthalenes	25	(16%)	27
dibenzothrophene	5.6	(39%)	28
phenanthrene	22	(28%)	11
anthracene	1.6	(125%)	81
C1 dibenzothrophene	13	(97%)	57
C2 phenanthrenes/anthracenes	62	(30%)	20
fluoranthene	3.7	(24%)	23
pyrene	3.8	(14%)	13
C2 dibenzothiophenes	5.0	(50%)	65
C2 phenanthrenes/anthracenes	29	(24%)	26
C3 phenanthrenes/amthracenes	21	(53%)	49
Benz(a)anthracene	1.2	(50%)	83
chrysene	8.1	(24%)	32
C4-phenanthrenes/anthracenes	3.8	(79%)	103
benzofluoranthenes	7.9	(50%)	96
benzo(e)pyrene	15	(37%)	28
benzo(a)pyrene	53	(74%)	28
perylene	91	(68%)	34
Total	190	(10%)	11

a) $s = \left[[1/n_1 + n_2 + ..n_{i-1}] \; [(x_{1i} - x_{1j})^2 + (x_{2i} - x_{2j})^2 + ... + (x_{ni} - x_{nj})^2] \right]^{½}$

b) $(\% \text{ rsd}) = s/x_{nj} \times 100$

DETERMINATION OF VISTA BASE OIL DETECTION LIMIT

Vista ODC is a narrow boiling range raffinate which gives a distinctive complex GC signature within the nC10 to nC16 range. Under the capillary GC conditions used in this study, over 150 components are resolved including approximately 15 to 20 prominent resolved peaks over an envelope of an unresolved complex mixture (Figure 4). The major resolved components appear to be isoprenoid hydrocarbons, naphthenes and the normal alkanes from nC11 to nC14. The normal alkanes are not a prominent set in the GC trace. At lower concentrations of oil, the distinctive features of the Vista GC pattern are lost leaving the isoprenoids as the primary Vista markers. Several of these same isoprenoid hydrocarbons are prominent in the Beaufort Sea surficial sediments, and the detection limit of Vista in these sediments is raised. The hydrocarbon levels in the study area sediments are a function of sediment particle size. Total alkanes, ranging from an average of 9200 ng.g-1 for predominantly (>98.5%) clay/silt typical of background surficial sediments to 310 ng.g-1 for predominantly (>98.5%) sand used for island and berm construction. Isoprenoid concentrations vary in a similar manner with particle size. Clearly, the Vista detection limit will also be a function of particle size and will be highest (i.e. the GC method least sensitive) for predominantly clay/silt surficial sediments and lowest (i.e. most sensitive) for the sand/gravel used for island construction.

The Vista detection limit was determined for the instrument then in samples directly by spiking a typical study area sediment and a sediment extract. The instrumental detection limit was determined for the GC using a series of Vista standards (0.9 to 500 μg/mL), 1.0 mL of each spiked with the working internal standard and analysed by GC using the standard conditions. Calibration data was plotted up for six combinations of distinctive peaks, and the total of the ten conspicuous peaks, assigned generally as isoprenoid hydrocarbons, were selected as the Vista indicators. The peak assignments, names used in tabulation and Kovats index (Kovats and Keuleman, 1964) of these components is shown in Table 5 and these peaks labelled in the Vista chromatogram (Figure 4). With the standard GC conditions, the sum of the selected isoprenoid peaks can be converted to Vista using the expression:

(vista) = (sum selected isoprenoids) x 0.01953 + 13.77

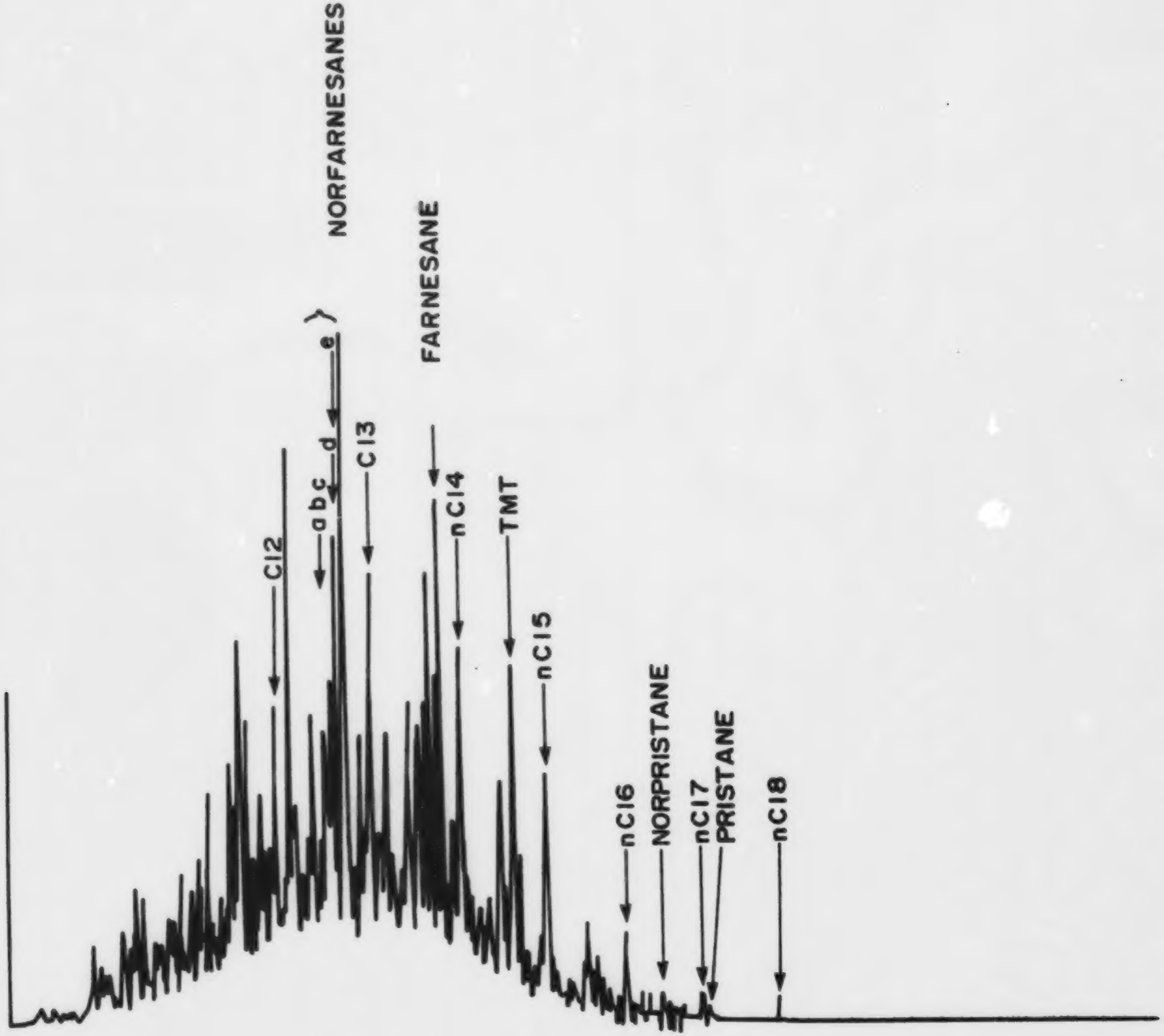


Figure 4. Gas chromatogram of the aliphatic fraction of Vista ODC base oil.

Table 5.

Kovats Indices of Indicator Isoprenoids

Tabulated Name	Kovats Index[a]
nonfarnesane-a[b]	1253
nonfarnesane-b[b]	1263
nonfarnesane-c[b]	1265
nonfarnesane-d[b]	1270
nonfarnesane-e[b]	1276
farnesane	1379
TMT[c]	1465
nonpristane	1653
pristane	1709
phytane	1814

a) Kovats index = $(R_i - R_n) / (R_n - R_{n+1}) \times 100$
where R_i = retention time of i
R_n = retention time of preceding n-alkane
R_{n+1} = retention time of following n-alkane

b) These compounds are not norfarnesane (2,6,10,trimethylundecane) but are non polar hydrocarbons with similar retention times to norfarnesane.

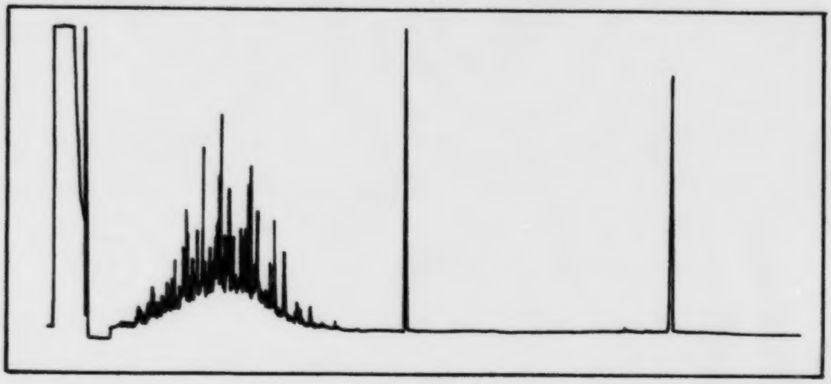
c) TMT = 2, 6, 10 trimethyltridecane

where the isoprenoids values are entered in nanograms and the resulting Vista values are given in micrograms. The absolute instrumental detection limit for Vista was found to be 20 ng Vista injected which is equivalent to 0.2 μg/g for a 10 gram sample, analysed using standard conditions.

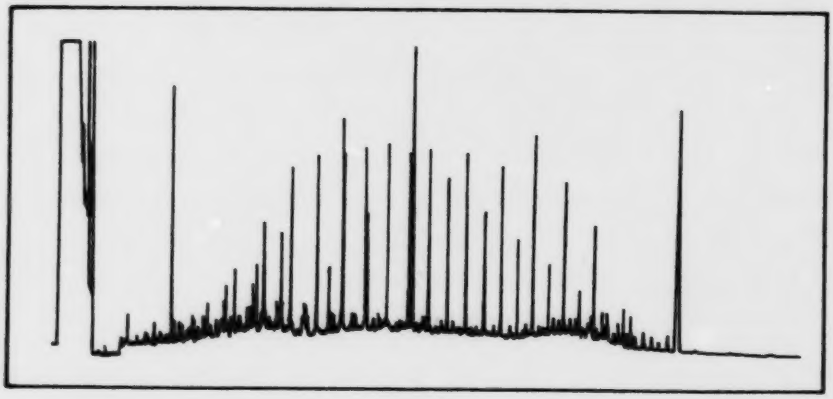
The detection limit in study area sediments was determined directly by the Minimum Detectable Vista Oil (MDVO) experiment. A typical area sediment (Minuk predrilling sample 3-07, collected October 1985, 300 m from Minuk island centre, 52.2% clay and silt) was homogenised by stirring and split into five subsamples. Four subsamples were spiked with 1.0 mL aliquots of Vista standards to give Vista dry weight concentrations of 24.57, 4.95, 2.47 and 0.495 μg/g and these analysed by the standard procedure. The resulting chromatogram for a 25 ppm spike is shown in Figure 5 along with GC traces from unspiked sediment and Vista samples for comaprison. The characteristic Vista pattern is masked by the background hydrocarbons and Vista cannot be distinguished from the background at 5 ppm and below. Based on this experiment, it was estimated that the detection limit in the study area sediments will be between 5 and 25 μg/g.

Using the Vista indicators found in the background samples, a detection limit was calculated based on the mean level and variance of these components for a given particle size range. For the purpose of this study, Vista was taken to be the sum of the 10 target low molecular weight isoprenoids that exceeded the 95% confidence limit for a given particle size as predicted from background samples (see Results section). The detection limit on this basis ranged from 15 ppm (Vista) in 100% sand to 130 ppm Vista in 100% clay/silt sediments (Figure 6). This proved to be a conservative estimate for background sediments (high silt + clay content) as a distinctive Vista pattern could be seen in some samples which did not have detectable Vista by the above definition. The relationship of the isoprenoids, PAH and barium to particle size is discussed in the results section.

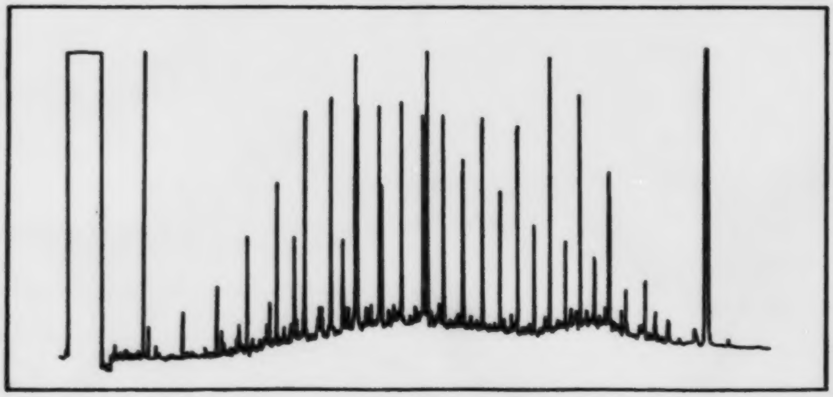
Escaid 90 was used to supplement stocks of Vista at Kaubvik. Although GC traces of the two oils are qualitatively similar, there are significant differences in composition (Figure 7). Escaid 90 is a more volatile base oil with major components eluting from Kovats 900 - 1300 (1100 maximum). By comparison, Vista major components elute from Kovats 900 - 1600 (1200 maximum). Normal alkanes nC10, nC11 and nC12 comprise about 20% of the total peak area of Escaid but less than 5%



Vista oil non polar fraction



25 ppm Vista spiked sediment



Unspiked sediment

Figure 5. Comparison of gas chromatograms of the aliphatic fraction of Vista base oil, background sediment and background sediment spiked with 25 ppm of Vista oil.

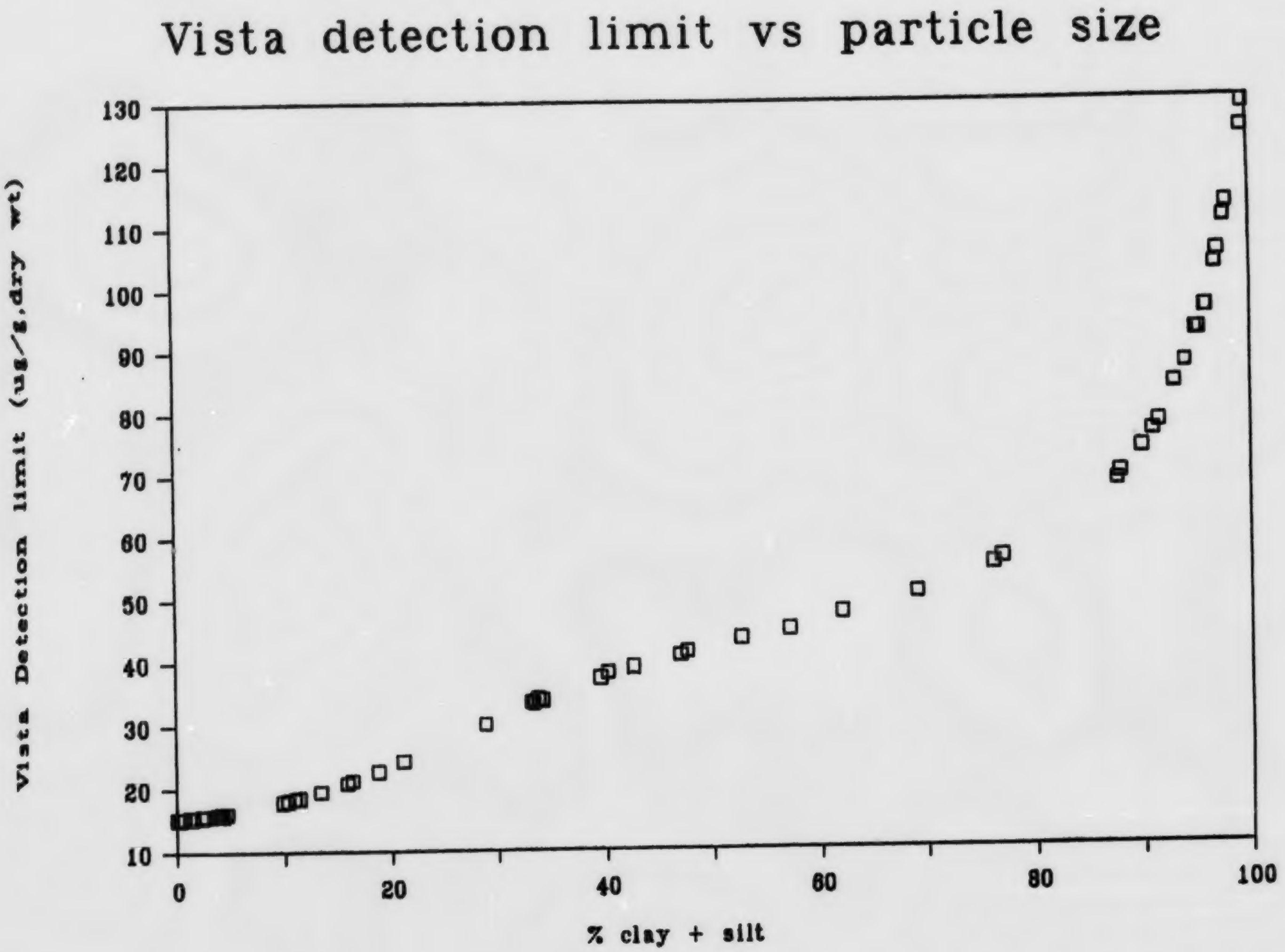


Figure 6. Detection limit for Vista ODC as a function of particle size.

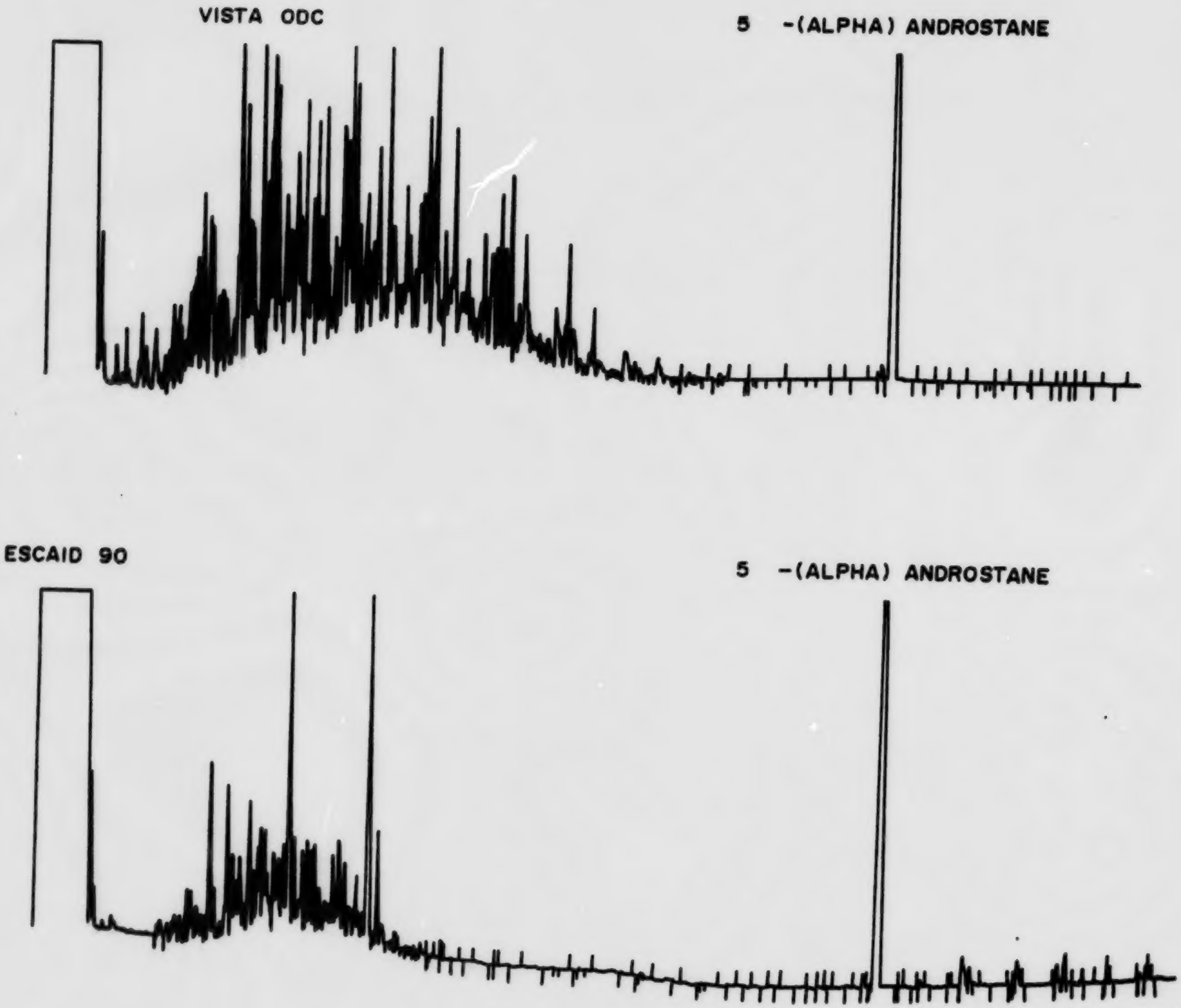


Figure 7. Comparison of gas chromatograms of aliphatic fraction of Vista ODC and Escaid 90 base oils.

in Vista. The norfarnesane group (at 1270 Kovats) are minor components of Escaid and the higher isoprenoids are present in negligible quantities. Consequently the selected isoprenoids used as a set of Vista markers are not sensitive to the presence of Escaid. No attempt was made to quantify Escaid. Qualitatively its presence in samples containing base oil at Kaubvik could be detected on the basis of the relative abundance of nC10-nC12. These alkanes are summed for Kaubvik series 6 samples in Appendix B.

BARIUM ANALYSES

Sediment samples were prepared for analysis at Seakem. Samples were first homogenized, then subsampled, dried to constant weight, ground in an agate mortar and sieved through a 63 mm (230) mesh sieve.

Barium analyses were done under subcontract to Quanta Trace Laboratories Ltd. in Vancouver B.C. Sediment samples (0.5 g) were digested by fusion with $Li_2B_4O_7$ in $LiNO_3$ with dissolution of the melt in nitric acid. Digests were analyzed by flame AAS using a N_2O - C_2H_2 flame. This method was chosen on the basis of its excellent detection limit and high degree of precision. Barium sulfate generally resists attacking the standard acid digests employed for many elements. As a result these methods suffer from poor sensitivity and incomplete recoveries.

Blind replicates and reference materials were submitted to provide an indication of accuracy and precision. Precision of blind replicate analyses of the same sample was 3% (relative standard deviation). Blind analyses of reference materials (NRC MESS-1; BCSS-1) gave results 40% high in series 1; 16% high in series 2 and within 3% for series 3, 4, 5 and 6 (Table 6).

PARTICLE SIZE ANALYSIS

Sediment grain size analysis was done by Thurber Consultants of Victoria by the hydrometer and sieve method using seven sieves (No. 10, 20, 30, 60, 100, 200 and 230 standard mesh sizes). The analysis provided percent gravel, sand, silt, and clay and a plot of percent smaller against size range from 50 mm to 0.001 mm. A number of blind replicate samples were submitted for analysis with each suite to provide an

Table 6.
Blind Replicate and Reference Material Analyses of Ba in Sediments
(values in μg/g)

Series	Blind Replicates[a]	MESS-1[b]	Difference	BESS-1[b]	Difference
1	1050 ± 43	365	+35%	-	
	(n=5)	397	+47%		
2	1170 ± 61	-		385	+17%
	(n=3)	-		379	+15%
3	959 ± 41	272 ± 24	+1%	-	
	(n=3)	(n=3)			
4,5	1010 ± 28				
	(n=5)				
6	-	277 ± 6	+2.6%	-	
		(n=3)			

a) reference site sediments: (n is in brackets) mean ± 1 std. deviation.

b) MESS-1; NRC Ottawa; marine reference sediment: accepted value 270 μg/g; analyzed "blind"

c) BCSS-1; NRC Ottawa; marine reference sediment: accepted value 330 μg/g; analyzed "blind" indication of precision. Results for replicate samples were all within 3% of the original results for the 3 size classes (% sand, silt and clay).

RESULTS

All hydrocarbon, grain size and barium data are tabulated for each well site according to strata in Appendix A (Minuk) and B (Kaubvik). Comparison of strata means for total aliphatics, sum alkanes and sum of isoprenoids was not a sensitive indicator of the presence or distribution of Vista. Much of the reason for this is a result of the strong relationship between hydrocarbons and sediment grain size coupled with the wide range of grain size characteristics close to the well sites.

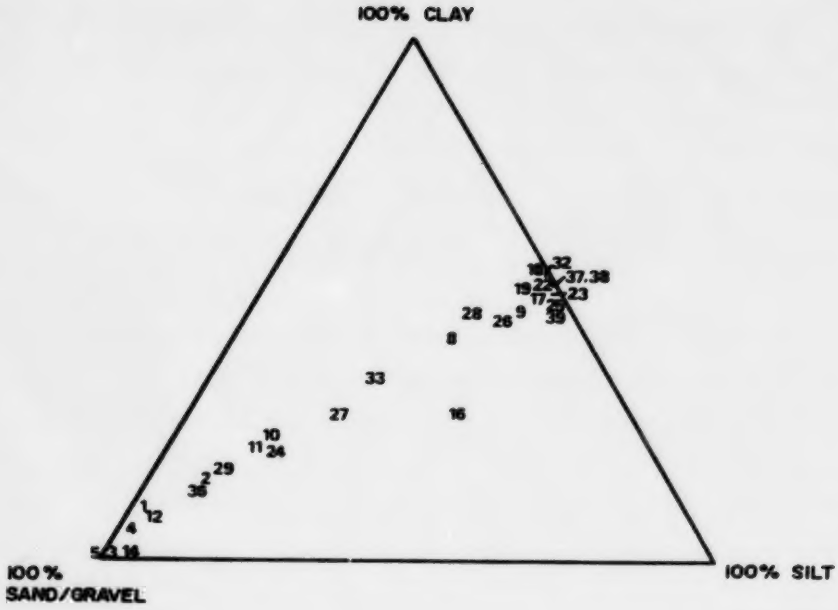
SEDIMENT GRAIN SIZE

Sacrificial beach islands and sub-sea berms are constructed from sand which is dredged from sites located several miles from the study area and evidently has a low metal and hydrocarbon content. The background surface sediments in the area of both the Minuk and Kaubvik well sites were found to be a mixture of roughly 50% silt and 50% clay sized particles. As a result, there was a gradation from 100 % sand on the island or berm to 0% sand at locations removed from any influence of island or berm construction. Triangular plots of grain size characteristics of sediment samples from both well sites prior to drilling (series 2 and 3, Figure 8) clearly indicate the nature of the two end members with a simple addition of dredged sand to background sediments giving rise to the variable sand content sediment observed at many of the sites.

ANALYSIS OF THE GRAIN SIZE RELATIONSHIP FOR BARIUM AND HYDROCARBONS

There is a positive relationship in Beaufort Sea sediments as elsewhere between the percent fine grained sediment and metal and hydrocarbon concentrations (Hoff and Thomas, 1986). As a result of the wide range in sediment particle size , it

A) KAUBVIK – BACKGROUND



B) MINUK – BACKGROUND

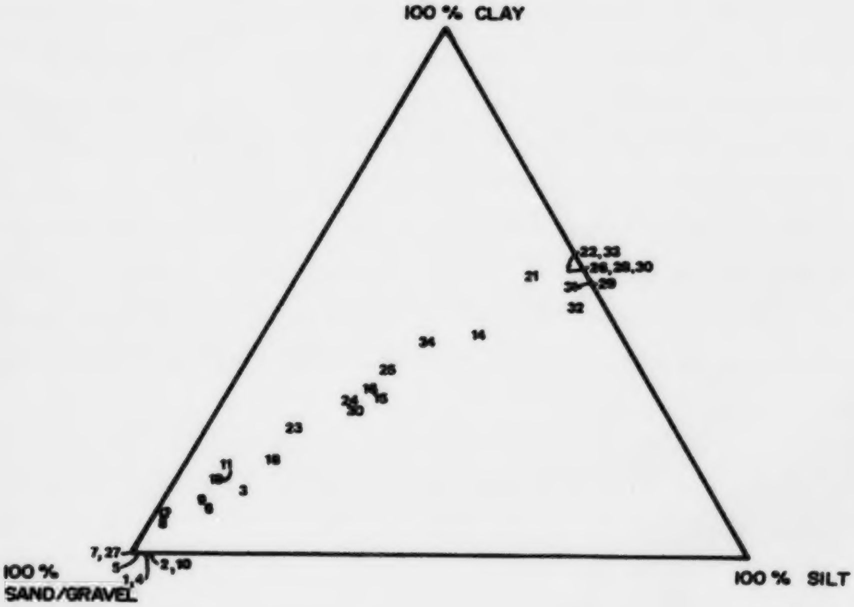


Figure 8. Triangular plots of grain size for samples collected near Kaubvik I-43 and Minuk I-53.

was necessary to examine the relationship between the percent fine grained sediment and Ba and base oil concentrations in pre-drilling samples. The sum of the clay + silt was used as a measure of the fine grained sediment (no difference was found if clay or clay + silt was used; therefore the sum was chosen).

The following non-linear (univariate) regression model was used to describe the pre-drilling relationship for both Ba and Vista:

$$Y = b^i{}_0 + b^i{}_1 x + b^i{}_2 x^2 + \ldots + b^i{}_m x^m + e, \quad (i = 1,\ 2, 3)$$

where for a given series i (2 or 3), Y is the log = $\log_{10}$ transform of the concentration of either Ba or Vista, x is the particle size (% clay + silt) of the sediment, the b's are the unknown coefficients to be estimated and e is the random, or unexplained, part of Y. The constant $b^i{}_0$ represents the overall (background) level for series i, and $b^i{}_1$, $b^i{}_2$, ..., $b^i{}_m$ measure the particle size effect for that series. Other than particle size, no other variables or factors were considered important in determining the concentration of barium or the sum of the 10 low molecular weight isoprenoids used as a measure of Vista.

The results of fitting a separate equation to each of series 2 and 3, are summarized below. In each case, the coefficients b_0, b_1, ..., b_m were estimated using unweighted least squares. The degree of the polynomial m was determined by plotting the data, the fitted equation, and the residuals; and by examining R^2 = coefficient of determination and the associated F statistic.

The fitted equations for series 2 and 3 were used to construct approximate 95% prediction intervals for the corresponding post-drilling samples, assuming that drilling has no impact and that there are no other interim changes in the particle size relationship. Series 2 was used to predict values for series 6; series 3 was used to predict the series 4 and 5 values. In general, the prediction interval is of the form:

$$Y(x^*) = y(x^*) + 1.96\ \text{s.e.}(y(x^*)),$$

where $y(x^*)$ is the fitted value of y that corresponds to a post-drilling sample sediment with particle size $x = x^*$ (i.e., calculated by substituting $x = x^*$ into the fitted regression equation) and s.e.($y(x^*)$) is the associated standard error when $y(x^*)$ is used to predict a future value of Y. Post-drilling levels that exceed the upper limit of the corresponding prediction interval suggest that there is a statistically significant drilling impact at the given sample site.

(a) Barium

There does not appear to be any obvious relationship between Ba and particle size for either of series 2 or 3. The mean (± the standard deviation) Ba concentration at Kaubvik (series 2) and Minuk (series 3) were 1122 ± 196 ppm and 812 ± 310 ppm respectively. A 95% prediction interval for post-drilling samples is shown for Minuk and Kaubvik in Figure 9. Most of the post-drilling samples at Kaubvik (series 6) are consistent with the background Ba levels while most of series 4 and 5 samples appear to be significantly elevated at Minuk.

(b) Vista ODC

The sum of the 10 target low molecular weight isoprenoids used to indicate and quantify the presence of Vista ODC in sediments show a strong positive relationship with particle size at both sites. A third order polynomial was used to fit log(Vista) as a function of clay + silt. Samples 3-3, 3-8, 3-14 and 3-35 appeared to be outliers and were omitted from the least squares fit for series 3. A 95% prediction interval for post-drilling samples is shown for Minuk and Kaubvik in Figure 10. One of the post-drilling samples at Minuk in series 4 (immediately after drilling during ice cover) was outside the predicted level while many of the samples from series 5 and 6 were significantly elevated over background levels. Examination of the GC traces of these samples indicated Vista was present in all elevated series 5 and 6 samples but was not present in the single series 4 sample with an elevated concentration. A summary of Vista concentrations in post-drilling samples is given in Table 7.

(c) Escaid 90 Base Oil

The 10 low molecular weight isoprenoids selected as indicators of Vista were not abundant components of Escaid 90 base oil used to supplement Vista during the drilling of the Kaubvik well. As a result, three n-alkanes, C10 to C12 were used to indicate the presence of Escaid 90. On the basis of series 2 data, 95% confidence

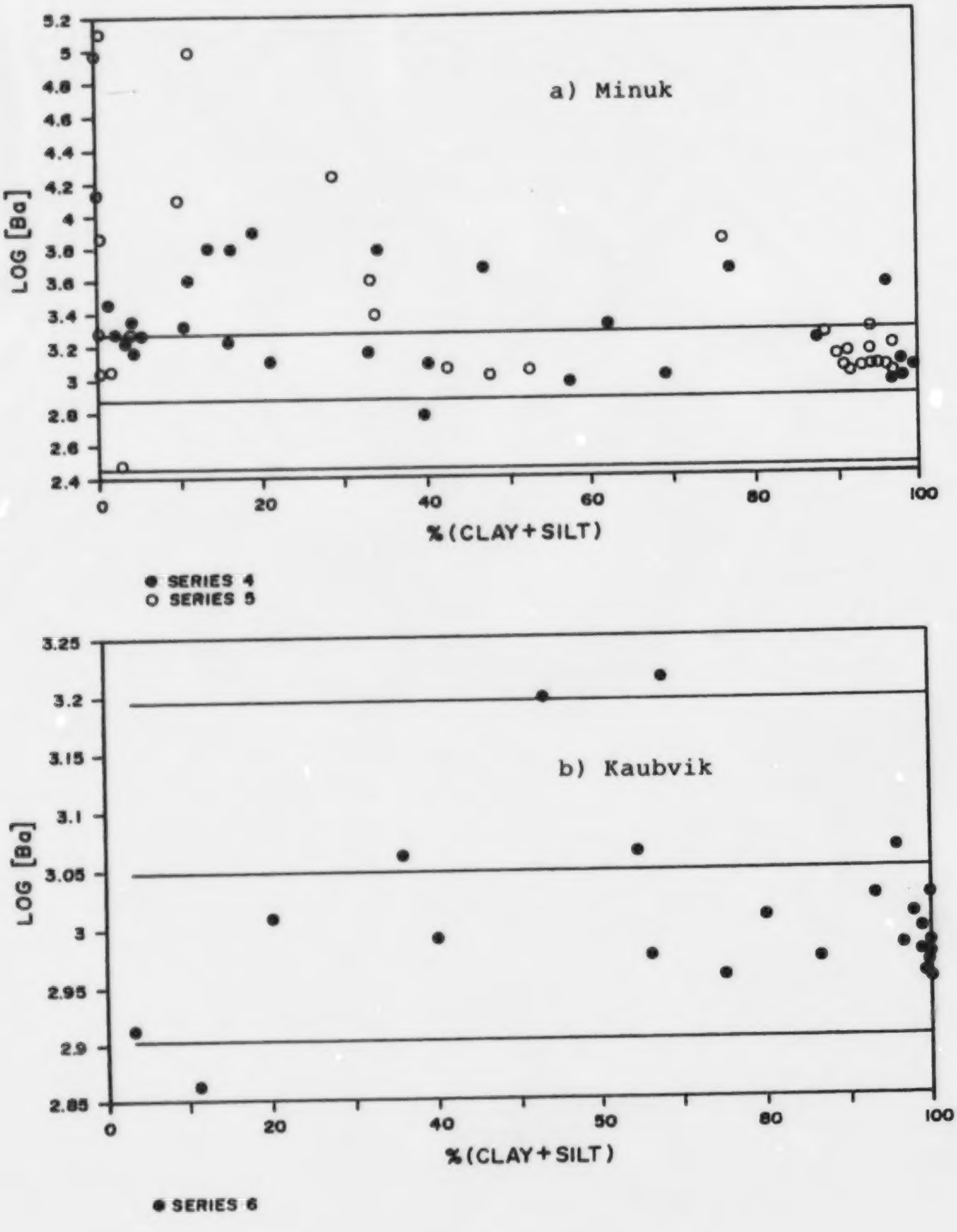


Figure 9. Log$_{10}$ Barium concentrations vs sediment particle size for post-drilling samples at Kaubvik and Minuk (95% confidence limits for series 2 and 3 data respectively are shown as solid lines).

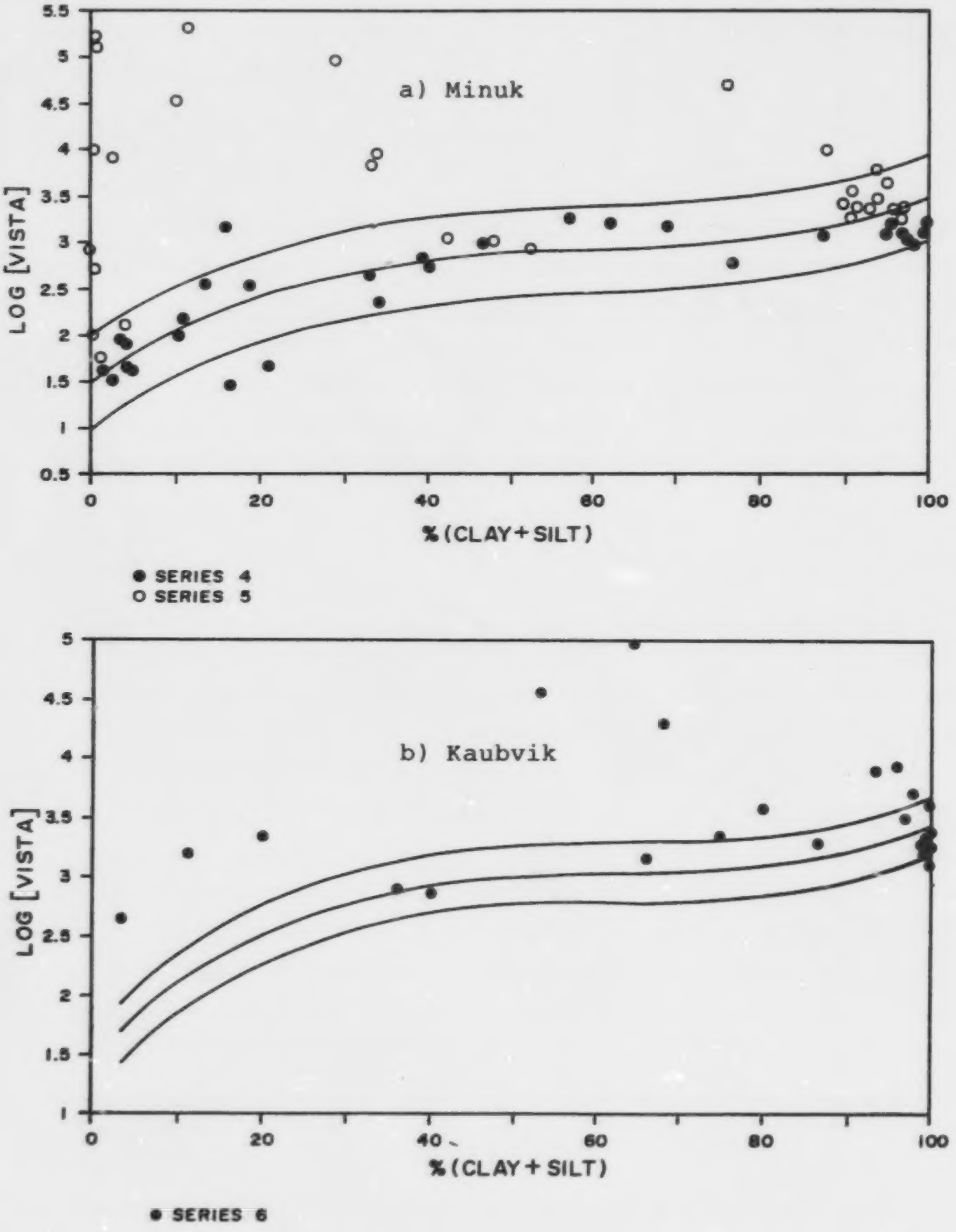


Figure 10. Log_{10} Vista concentrations vs sediment particle size for post-drilling samples at Kaubvik and Minuk (95% confidence limits for series 2 and 3 data respectively are shown as solid lines).

Table 7.

Summary of Vista ODC (equivalent) Concentrations in Post-Drilling Sediments

Series	Site	Sample Location[b]	Distance[a] (m)	Bearing(°)[a]	Vista ODC (μg/g)
5	Minuk	1	150	280	199
		2	200	320	16
		4	150	270	3024
		5	200	220	162
		9	300	210	125
		11	350	290	164
		14	450	230	10
		24	800	190	82
		26	350	210	691
		27	200	170	2034
		32	950	120	166
		33	600	110	1814
		34	350	110	4078
		35	650	80	958

Series	Site	Sample Location[c]	Distance[a] (m)	Bearing(°)[a]	Vista ODC (μg/g)
6	Kaubvik	1	260	230	130
		2	280	184	1929
		3	220	130	8
		4	300	138	722
		10	410	130	56
		15	390	241	124
		27	480	250	46
		30	259	270	38
		40	260	113	30
		41	390	114	376

a) from island centre
b) See Appendix A.
c) See Appendix B.

limits were derived and applied to the series 6 samples. Most (although not all) samples containing Vista also had elevated concentrations of the sum nC10-nC12 alkanes suggesting Escaid 90 was also present. Concentrations of Escaid 90 were not quantified. There were no samples with Escaid 90 present that did not also have quantifiable concentrations of Vista.

(d) PAH

A randomly selected subset (approximately one third) of all samples were analysed by GC/MS for a suite of 25 selected PAH indicated in the methods section. The total PAH concentration shows a similar relationship to particle size as found for the non-polar hydrocarbons and selected isoprenoids. Total PAH (non - log transformed) plotted against particle size for predrill series 2 and 3 and for post drilling samples is shown in Figure 11. These plots indicated the PAH concentrations were not significantly different after drilling. Samples 6-04 and 5-26 were the only post-drilling samples that were significantly above background. These samples also had high levels of base oil. However none of the other samples with quantifiable levels of Vista had elevated levels of PAH. The composition of PAH through all series was remarkably consistent as indicated by the maxima in alkyl homologue distributions (AHD) and parent compound distribution (PCD, Lake et al 1979). The two samples with elevated PAH were qualitatively different than the rest, having higher phenanthrene with respect to perylene. This suggests a different source of higher aromatic content material at these locations not directly related to dispersion of oiled cuttings. It was concluded therefore, that there was no significant aromatic input from the drilling as expected on the basis of the low aromatic content of the base oil. An increase in the concentration of aromatics in the sediments would be expected only if production wastes contained appreciable amounts of formation oils (Yunker and Drinnan, 1987). A complete summary of PAH data is given as Appendix D.

CORE SAMPLES

Vista oil was present on the basis of the distinctive signature of isoprenoids in the GC trace of the 0-2 cm core section of the core sample taken south of the island

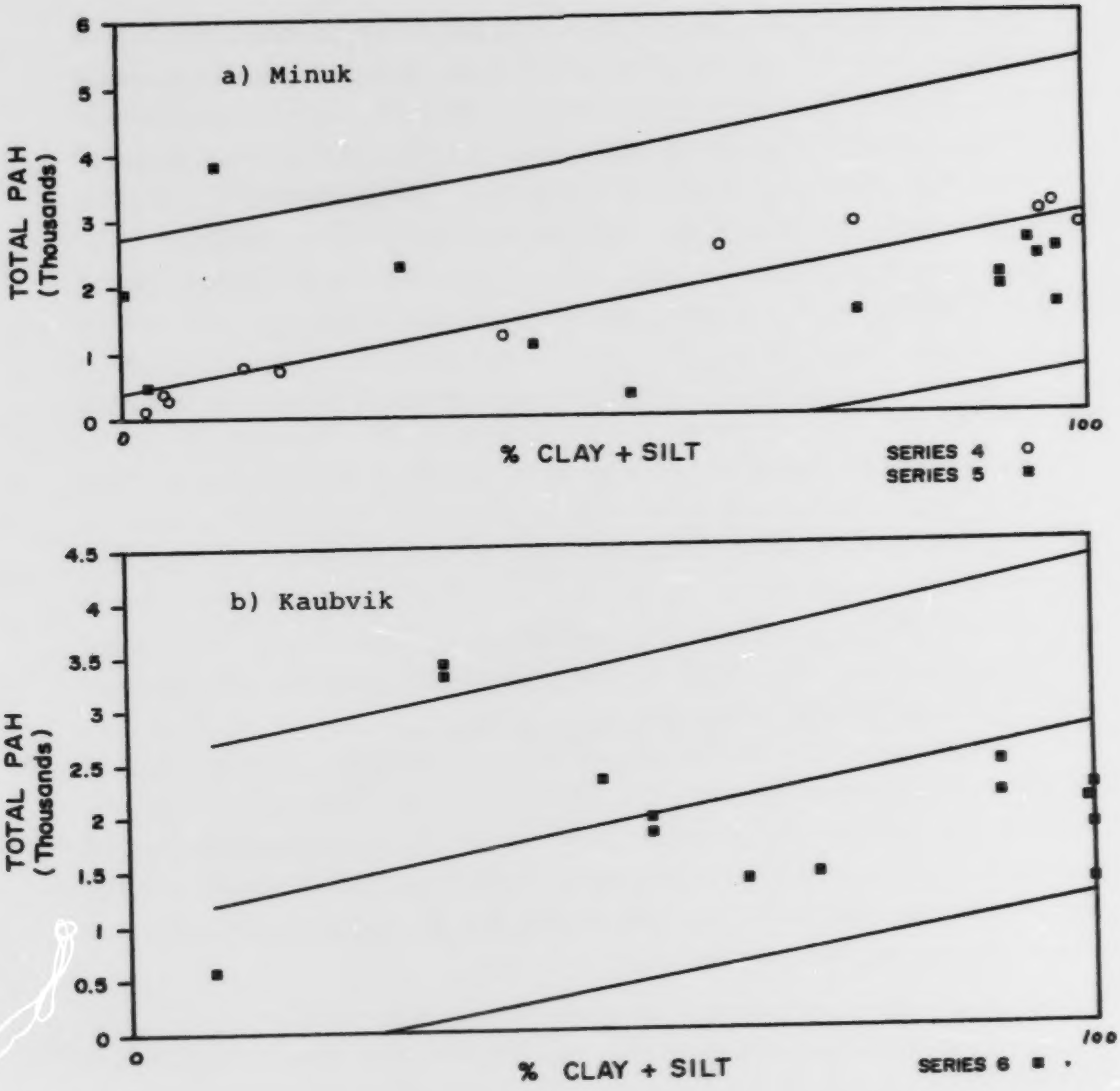


Figure 11. Total PAH vs sediment particle size for post-drilling samples at Kaubvik and Minuk (95% confidence limits for series 2 and 3 data respectively are shown as solid lines).

(380 m, 180°, Appendix B). The amount of Vista present was not quantified because no grain size measurements could be made with the amount of sample available. However, the amount of Vista present was low, likely less than 10 μg/g based on isoprenoid concentrations in deeper sections of the same core. No trace of base oil was found in the other cores or in the deeper sections of the south core indicating that there had been no burial of cuttings at this location (Appendix B).

TOTAL ALKANES

The sum of all alphatics or alkanes was not a sensitive indicator of base oil as virtually all the Vista components elute before nC18. However, non-polar hydrocarbon concentrations have been used and reported in other studies and these data have been summarized in Appendix A for Minuk and Appendix B for Kaubvik for comparison with other data sets. Background non-polar hydrocarbon concentrations varied from less than 500 ug/g in 100% sand on the island or berm to more than 15,000 ug/g in 100% silt + clay sediments. Maximum values in post-drilling samples were over 200,000 ug/g in sediments with base oil present or 1 to 3 orders of magnitude above background.

The sample with the highest total alkane levels was found 950 m due north of the Minuk island centre (sample 5-21). This sample contained large amounts of a lubricating or diesel oil and not Vista. There was an approximate equal amount of odd and even n alkanes with a maximum between nC24 and nC29 (Appendix A). The high concentration and type of oil at this location may be a result of oil lost from the island in September, 1985 as a result of storm damage.

CURRENTS

Usable current meter data is given in Appendix C. Currents as measured 1 km south of Minuk at a depth of 6.1 m in the September to October 1985 period had a general northeasterly trend. For the period in November 1985 for which a current record was obtained, the net flow was initially almost due east. Current speeds were generally less than 20 cm/sec in September and October with maximum speeds of over 40 cm/sec occurring during periods of strong winds (speeds were between 40 and

50 cm/sec for the 3 day period during the storm which damaged the Minuk island in September). Current speeds of over 30 cm/sec were recorded on November 10-11, 1985 but decreased to less than 15 cm/sec for the remainder of the 8 day record of the winter deployment. Net residual flows were 2.48 cm/s in open water and 3.71 cm/s in November to the north-east and east respectively (Figure 12; Appendix C).

No direct current measurements were made at Kaubvik during the drilling period. However, Esso Resources Canada Limited had current meters deployed the previous summer (July 27 - October 7, 1986) at depths of 6 and 19 m in the vicinity of Kaubvik (MacLaren Plansearch Limited, 1987). During this period there was a net residual flow of 4.6 cm/s to the northeast near the bottom (19 m).

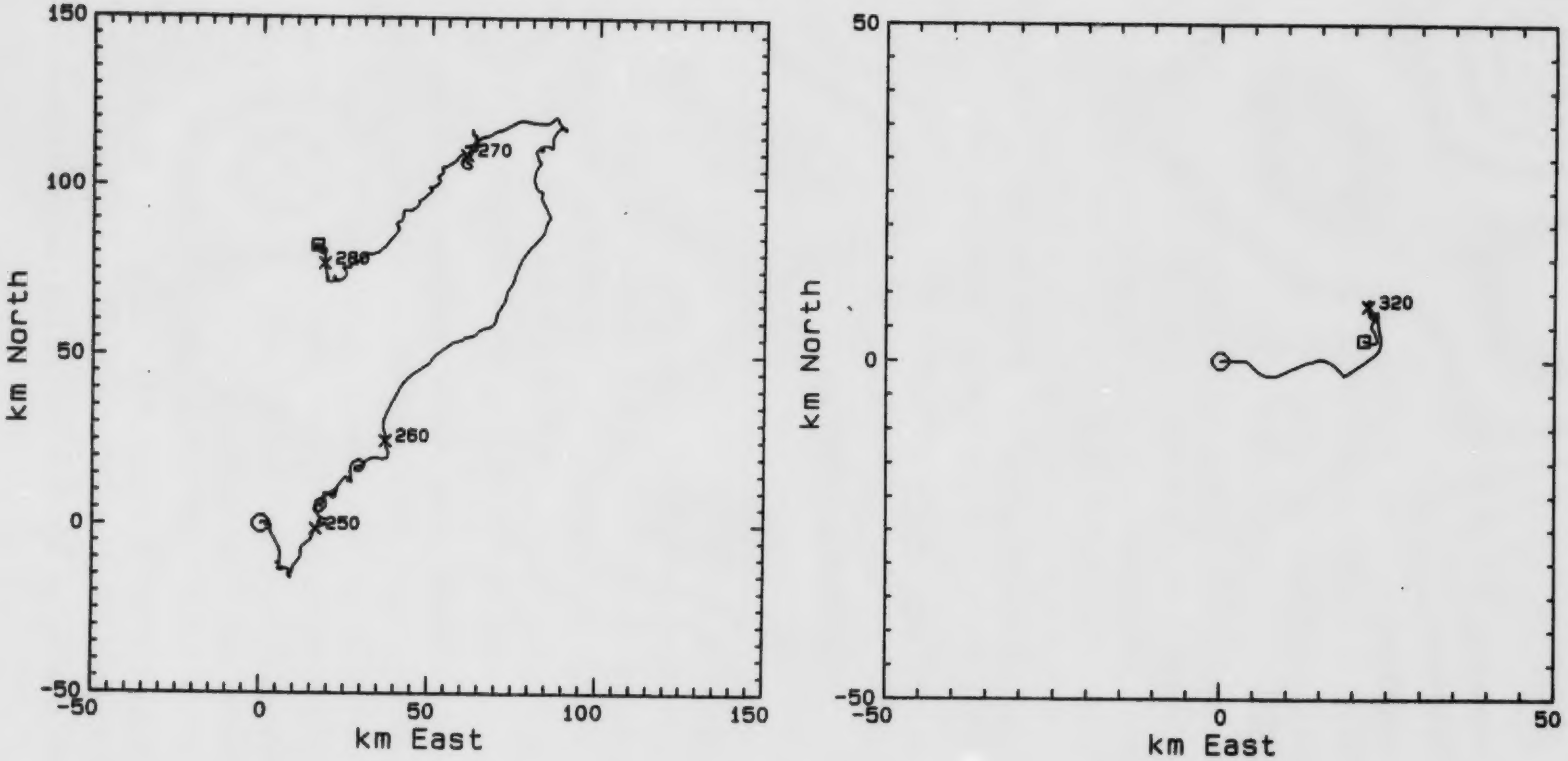
DISCUSSION

The results for each set of post-drilling samples are discussed below in terms of the areal extent of dipersal of base oil to surface sediments from OBDM discharged from each well site, potential mechanisms for dispersal and the fate and weathering of base oils over the period of the study.

DISPERSION OF OBDM

a) Post-Drilling Samples at Minuk (series 4)

There was no base oil detectable in any samples collected outside the ice rubble field. A single sample to the west, well beyond the ice rubble field did have elevated levels of the 10 isoprenoids but examination of the GC trace of this sample did not indicate a distinctive Vista pattern of peaks. The rubble field was not symmetrical and was most extensive to the west and northwest of the island (Figure 3). Ice accumulates where there are bottom obstructions that impede its movement so that the extension of the ice rubble field to the northwest reflects shallower depths in that region as a result of the migration of the island after the storm in September 1985 as well as the presence of some lost material and equipment. The edge of the rubble field was close to the island on the east and south sides however,



a) Progressive vector diagram of :
  Low pass filtered data
For :
  MINUK SOUTH DEEP
  From hour 1700 Day 243
  Instrument 5812 Tape 2

b) Progressive vector diagram of :
  Low pass filtered data
For :
  MINUK SOUTH DEEP
  From hour 0 Day 315
  Instrument 5812 Tape 0

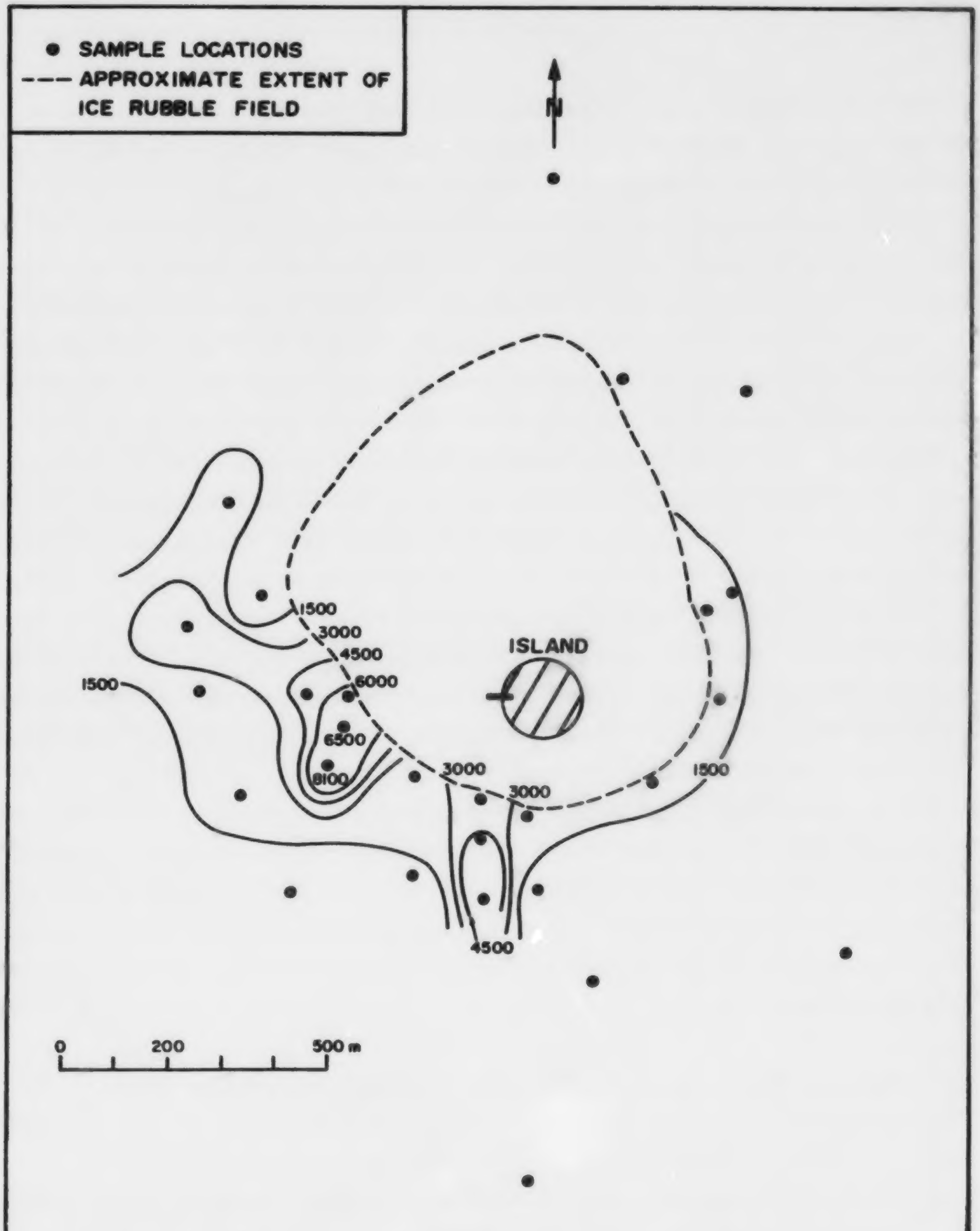
Figure 12. **Progressive vector plots of current data 1 km south of Minuk I-53; a) August 30 - October 10, 1985 and b) November 12 - November 20, 1985.**

so that it was possible to take some samples in that area that were within 200 m of the discharge line from the island. The results suggest that all waste OBDM was contained within the perimeter of grounded ice rubble.

Barium concentrations in most samples close to the island were elevated. A contour plot of Ba concentrations (Figure 13) indicates that the excess Ba originated from the island and, in the absence of base oil data, point to the discharge of OBDM during the the winter as the most likely source. However, since no trace of Vista ODC was found in any samples with excess Ba, another source must be involved. Two other possible sources which would not have an association with Vista were: 1) water based drilling muds used in the first few weeks of the drilling program, and 2) barite lost from the island as a result of storm damage to the island the previous fall. Water based muds were used in the initial stages of the Minuk well. Since these would have been discharged early in the winter before an extensive ice rubble field developed, barium could have been more widely dispersed. However, the quantity of barium from this source was small compared to the large quantity of barite (2,300 metric tons) lost from damaged storage tanks during salvage and clean-up operations after the storm damage in September 1985. The barite was released during salvage on the west side of the island (the same side as the discharge line) at about the same time as series 3 samples were being collected. It is likely that series 3 samples were not elevated because the barite had not been widely dispersed when samples were taken. Although barite was visibly present in the water, it was not possible to sample close to the storage tanks for logistic reasons. Given the large quantities of barite lost, this source would appear to be the most likely explanation for elevated sediment Ba observed in the post-drilling samples.

b) Samples from Minuk at the end of the Following Open Water Season (series 5)

While all the OBDM appears to have been contained within the rubble field in winter, widespread dispersion of Vista oil occurred after break-up. A contour plot of equivalent Vista oil concentrations shown in Figure 14, indicates dispersal of oil around the south side of the island and then in an easterly direction. The assumptions made in assigning density of samples to various strata were obviously not valid for the final sampling at Minuk. The area with the assumed lowest probability of an impact



● SAMPLE LOCATIONS
--- APPROXIMATE EXTENT OF ICE RUBBLE FIELD
N
1500
3000
4500
6000
6500
8100
1500
ISLAND
3000
3000
1500
4500
0
200
500 m

Figure 13. Contour plot of excess Ba in sediment at Minuk I-53 in April 1986, within 2 weeks of drilling completion.

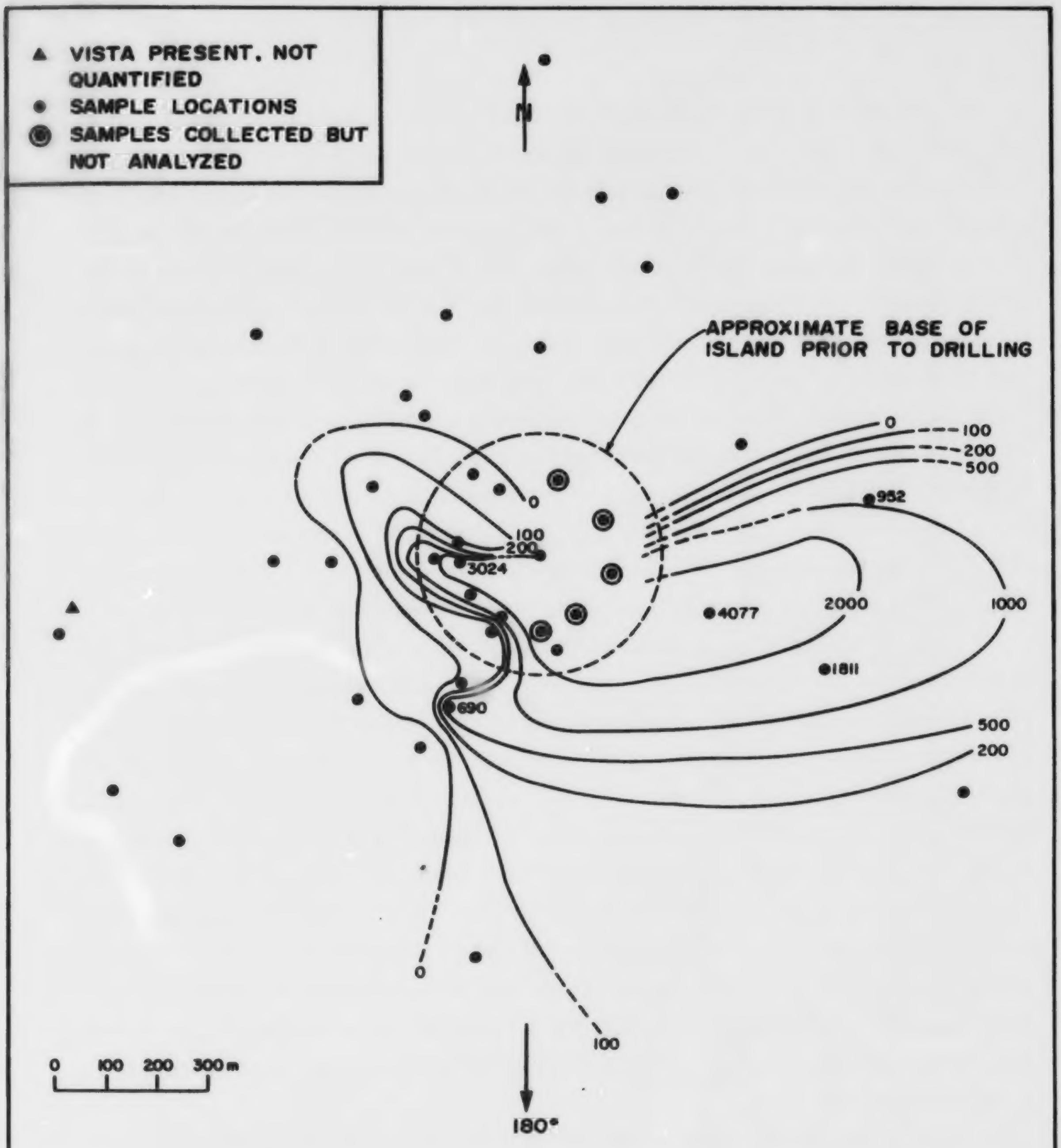

▲ VISTA PRESENT, NOT QUANTIFIED
● SAMPLE LOCATIONS
◉ SAMPLES COLLECTED BUT NOT ANALYZED
N
APPROXIMATE BASE OF ISLAND PRIOR TO DRILLING
0
100
200
500
952
100
200
3024
4077
2000
1000
1811
690
500
200
0
100
0 100 200 300 m
180°

Figure 14. Contour plot of Vista ODC sediment concentration at Minuk I-53 in September, 1986, one open water season after drilling.

on the opposite side of the island from the discharge point, appears to have received the greatest amount of oil. Because of the small number and position of the sampling locations to the east and south, it is not possible to define the outer limits of detectable Vista dispersal. The maximum concentration of Vista found was in a sample to the southeast of the island, about 350 m and on the opposite side of the island from the discharge point. Concentrations of low molecular weight isoprenoids were more than 1000 times background values. Extrapolation of the contours suggests that Vista would be quantifiable more than 1 km from the island to the east.

Some samples that did not have levels of low molecular weight isoprenoids in excess of the 95 % confidence level for the particle size of the sample, did have detectable levels of Vista on the basis of the distinctive pattern of peaks in the GC trace. A signature of Vista was noted in the GC trace of a sample taken 950 m at 260° from the island centre, for instance, indicating dispersal of small quantities of oiled cuttings almost 1 km to the west of the island as well (Figure 15).

The direction of movement of the majority of dispersed oil is in general agreement with the net residual flow recorded by the current meter 1 km south of the island (2.48 and 3.71 cm/s to the northeast and east respectively in September and November). However, dispersal of Vista oil was far more extensive than might be assumed given the apparent confinement of oil before ice break-up, the short open water season and available data on maximum currents. On the east coast, near Sable Island, for instance, Yunker and Drinnan (1987) found that detectable base oil was more confined at a well site in similar water depths but with a much more energetic ocean environment. Although a signature of base oil was noted in GC traces of some sediments as much as a 1 km away from the site, concentrations were not elevated more than 10 times background beyond 200 m from the well centre (sediments in that area were 100% sand making detection limits of base oil the same close to the well as at distant locations).

The reason for the dispersal of OBDM over a large area and greater distances at Minuk may be related to ice movements. While the grounded ice rubble on the island slope confined the OBDM in winter, it also provides a potential mechanism for dispersal after ice break-up. As the ice around the island melts and breaks-up in early summer, the grounded ice rubble eventually floats free and drifts off in the direction of the prevailing currents and wind direction. As it drifts away, some of this ice may scour the bottom and if oiled cuttings are present, may carry them some distance from

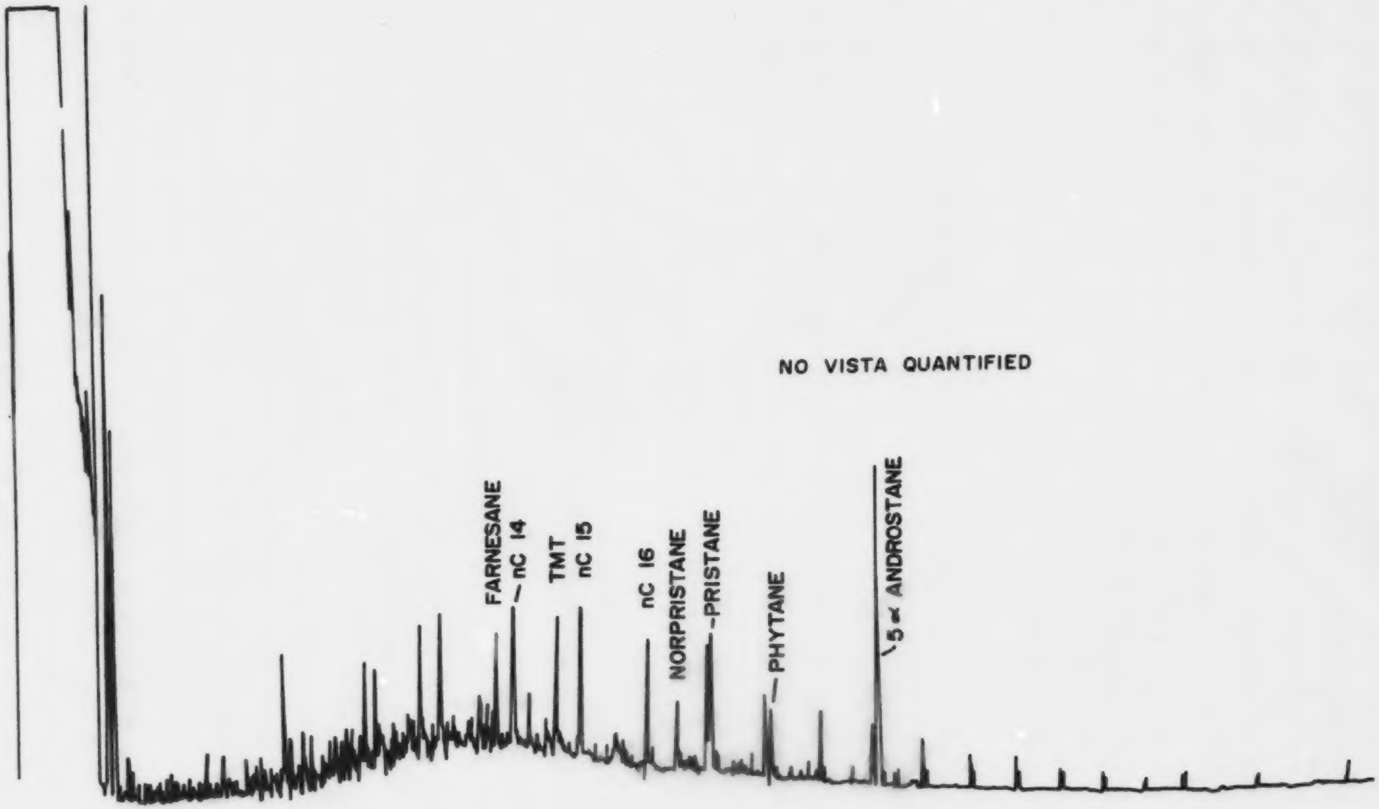


Figure 15. Gas chromatogram of aliphatic fraction of a sediment sample 950 m to the west of the Minuk Island Centre, series 5 (one open water season following drilling).

the island. In addition, some cuttings may actually be held in the ice nearest the discharge point and be released as the ice melts.

There was a direct correlation between Ba concentrations and samples with Vista oil present in series 5 (Figure 16) suggesting that a similar mechanism is responsible for Ba dispersal. Maximum Ba concentrations (100,000 ppm) were an order of magnitude higher than maximum levels observed in series 4 immediately after drilling and two orders of magnitude above background.

(c) Post-Drilling Samples from Kaubvik (series 6)

Sampling at Kaubvik was approximately 7 months after drilling was completed (early January, 1987) and about 3-4 weeks after ice break-up. Samples were collected just prior to dismantling of the caisson so that there was considerable ship activity in the area. A contour plot of excess low molecular weight isoprenoids shows clearly the presence of Vista in the immediate vicinity of the discharge point and dispersal mainly to the east as observed at Minuk with some cuttings dispersed up to 400 m to the west (Figure 17). There was a very steep gradient in base oil concentrations in sediments directly to the south of the caisson.

On the basis of the normal alkanes nC10, C11 and C12, the presence of Escaid 90 could be inferred in GC traces of many of the samples with detectable amouts of Vista. Since Escaid was not measured, concentrations of base oil in these samples will have been underestimated. The sediment trap provided a time integrated estimate for the relative contribution of the two base oils. Escaid 90 is present in this sample but at lower concentrations than Vista in agreement with the relative abundance of the two oils used in drilling mud (ESSO Resources - personal communication).

The areal extent of dispersion was more restricted than observed at Minuk after one open water season. OBDM was discharged from Kaubvik in the early winter and was not confined by an extensive build-up of ice rubble. Ice scouring of the berm slope and wave action will not therefore have been as important in the dispersion of oiled cuttings at the time samples were taken compared to samples taken at Minuk. The observed distribution of base oil in surface sediments near Kaubvik, therefore can be assumed to be primarily the result of currents and is in agreement with the observed direction of net residual currents observed in the area the previous summer.

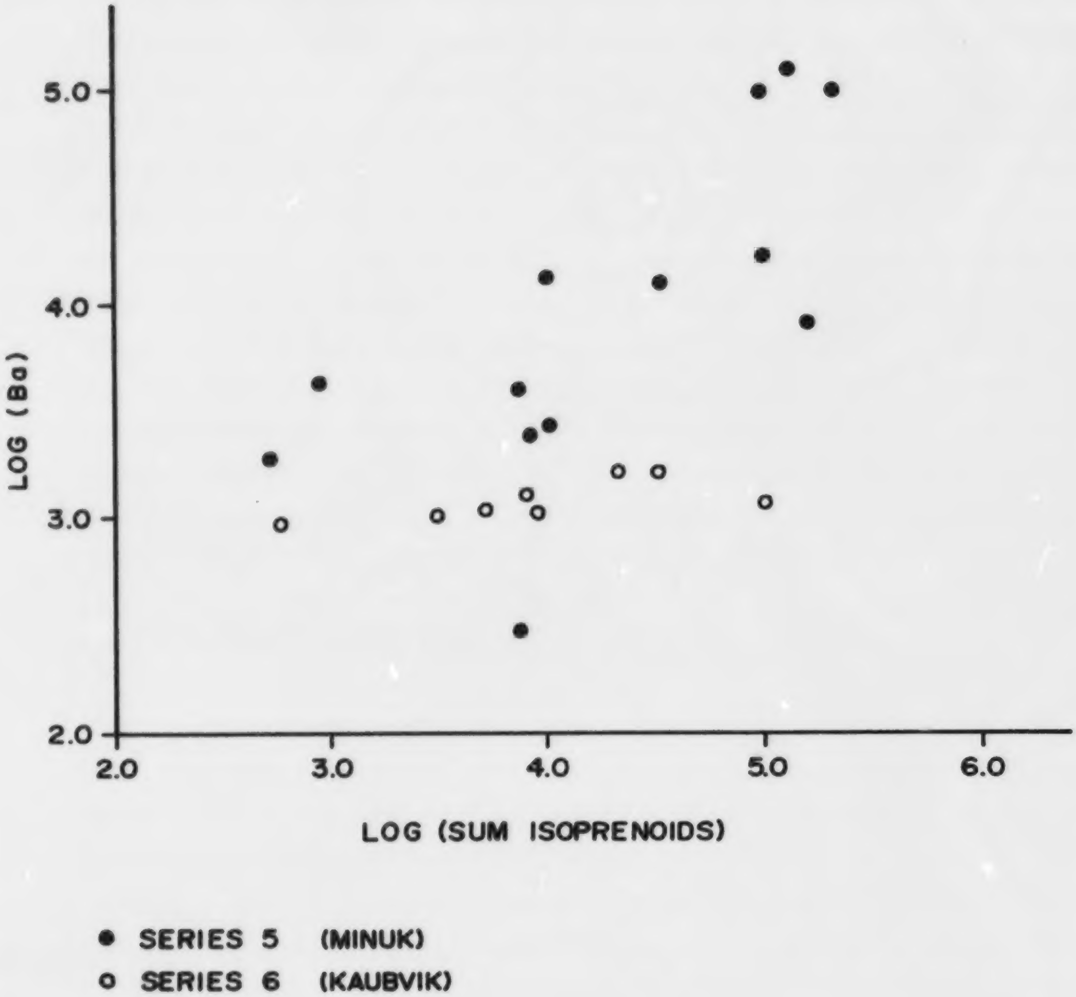
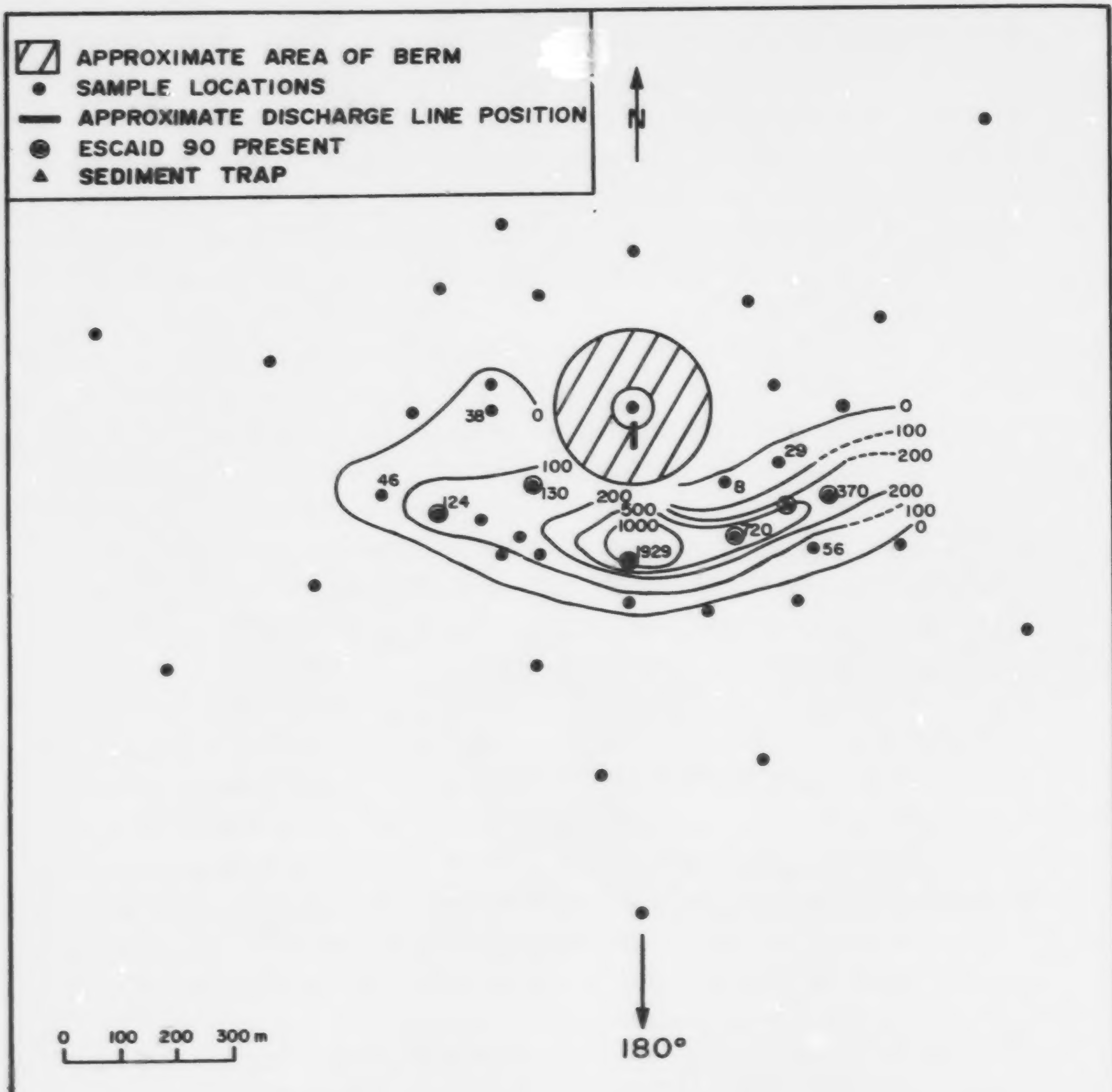


Figure 16. Relationship between Vista concentrations and Ba in follow-up sampling at Minuk and post-drilling sampling at Kaubvik.



APPROXIMATE AREA OF BERM
SAMPLE LOCATIONS
APPROXIMATE DISCHARGE LINE POSITION
ESCAID 90 PRESENT
SEDIMENT TRAP
N
38
0
46
100
130
124
200
500
1000
1929
8
29
370
720
56
0
100
200
200
100
0
0 100 200 300 m
180°

Figure 17. Contour plot of post-drilling Vista ODC sediment concentrations at Kaubvik I-43, August 1-4, 1987.

There was only a very weak relationship between Ba and base oil concentrations in sediments at Kaubvik (Figure 16). Ba concentrations were much lower than at Minuk with the highest concentration of 1600 ppm being only slightly above the upper 95% confidence interval predicted from background sampling. Samples at Minuk with similar levels of Vista had Ba concentrations up to 50 times higher. Some of the difference may reflect the greater quantities of barite either lost or discharged with drilling wastes at Minuk (approximately 10 times as much Ba was discharged/lost). The weaker correlation between Ba and Vista at Kaubvik may also reflect a difference in the principal mechanism for dispersal. Moving ice would be able to transport higher density material such as barite greater distances and in larger quantities than ocean currents. The observed Ba/Vista relationship at Kaubvik may therefore indicate a differentiation between base oil and Ba on the basis of density whereas the strong correlation at Minuk is an indication that ice movement was the dominant factor in dispersal at that site.

ADEQUACY OF SAMPLING PLAN

It is informative to consider the original sampling plan in the light of the actual results. The stratified random allocation of sample sites was based on the relatively small number of sampling sites allowed by budgetary constraints (25) and certain assumptions regarding the "zones of influence".

At Minuk, the actual distribution of oiled cuttings was very different from the predicted distribution: the highest concentrations were in the area that was expected to have the lowest probability of an impact. As a result, very few samples were taken in this region and the outer limit of detectable base oil contamination uncertain. In this respect, a systematic allocation of samples at 45° intervals in concentric circles of 100, 500 and 1000 m (total of 24 samples) would have been more effective in defining an outer limit. Future monitoring in the vicinity of sacrificial beach islands should therefore take into account the potentially erratic and widespread distribution of oiled cuttings that may result. A dense allocation of systematically selected stations would therefore be more appropriate.

The stratified random sampling plan at Kaubvik was adequate for detecting the fate of oiled cuttings and provided a detailed indication of the distribution pattern. However, as the discharge was to the south and evidently perpendicular to the direction of net current flow, the strata could have been more effective if defined in terms of a 180° arc through the centre rather than 120°.

WEATHERING AND FATE OF BASE OILS

(a) Weathering

Because a time series of samples was not collected from sites where base oils were detected, no direct information is available for the rate of loss of oil from the sediment. Dissolution and evaporation will gradually decrease sediment oil concentrations. Yunker and Drinnan (1987) noted an almost 100 fold decrease in the concentration of Vista oil in the cuttings pile at the West Venture site (16 m water depth) over a three month period. The cold water temperatures and less energetic environment in the Beaufort will likely result in a slower loss than observed on the east coast. The use of isoprenoid compounds as base oil markers in this study will also tend to minimize the effects of weathering as these compounds are generally more resistant to biodegradation than normal alkanes.

Qualitative changes between fresh Vista ODC and Vista in sediments were observed however, at both sites. Differences were a function of distance from the discharge point and concentration. There were also differences between sites. The Vista in use at Minuk had slightly more volatile components than in the standard Vista originally supplied and used for calibration (Figure 18). However there were negligible changes in the concentrations of the selected isoprenoids.

At Minuk in series 5 samples, substantial changes can be seen in the original Vista on the basis of GC traces of samples containing distinctive base oil patterns (Figure 18). The changes can be summarised as a decrease in complexity with 10 conspicuous peaks emerging from the original complex Vista pattern. The unresolved envelope also decreased and there is a shift in the centre of the envelope from around nC13 to nC14 or higher. Included in the group of remaining conspicuous peaks are most of the selected 'Vista' isoprenoid marker peaks which will artificially improve the sensitivity of the method for weathered or aged base oil. The calibration factor used to convert from total selected isoprenoid to Vista was based on undegraded Vista, so that the reported 'Vista' values for weathered samples will be higher than the sum of the residual peaks would indicate.

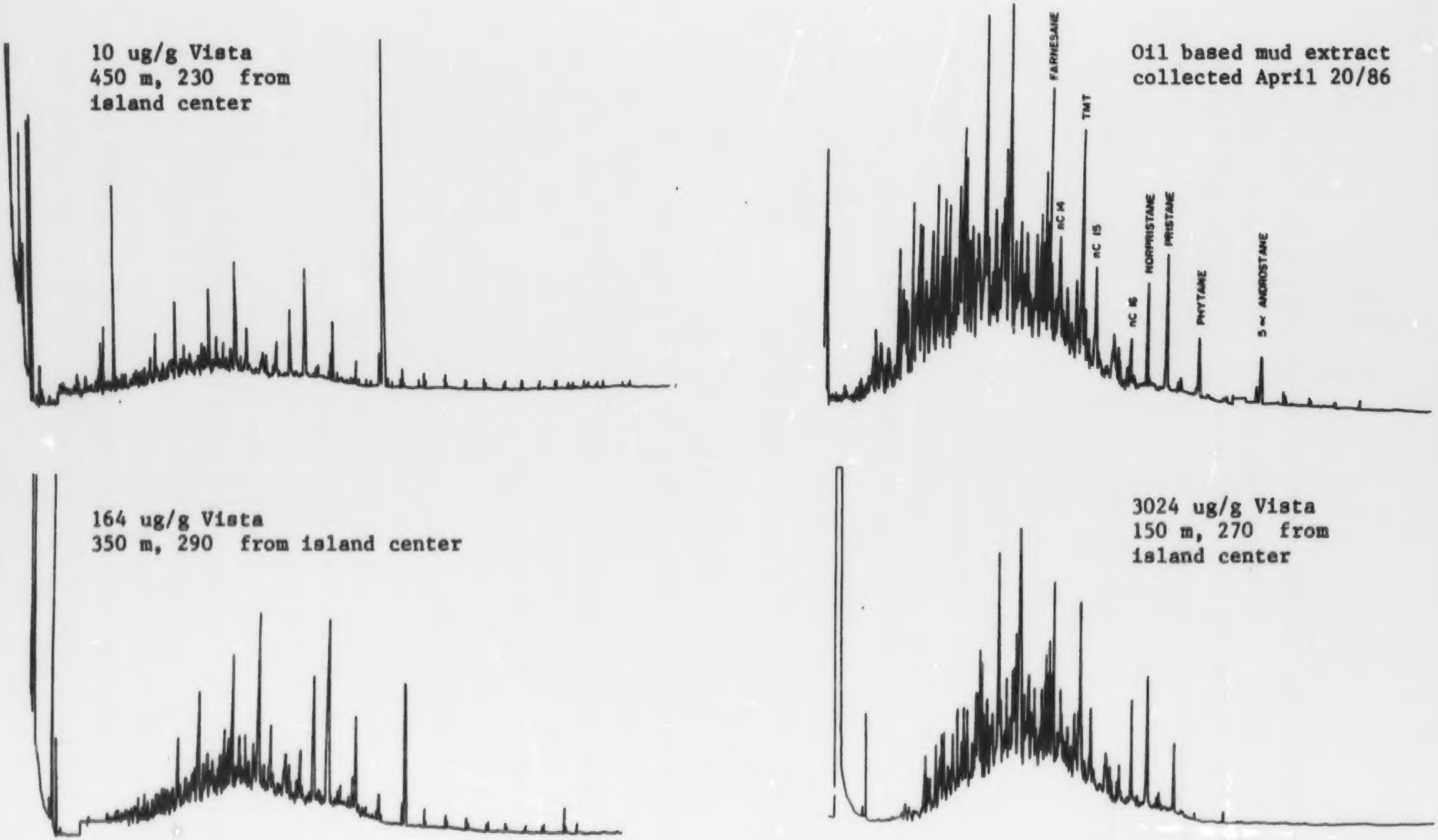


Figure 18. Gas chromatograms of the aliphatic fraction of follow-up sediment samples (series 5) containing vista base oil at Minuk I-53.

Similar changes are apparent at Kaubvik (Figure 19) but the inclusion of a different base oil, Escaid 90, makes direct comparison between the sites difficult.

At both sites, weathering is most pronounced in samples furthest from the discharge point presumably as a result of the greater distance travelled and hence water column residence time.

The material recovered from the sediment trap, deployed for 11 months at a distance of 250 m and an angle of 120° from the Kaubvik caisson centre, showed a substantial quantity of Vista and Escaid 90 (Figure 20). Qualitatively, the trap material was unchanged base oil, and similar to the Vista used at Minuk. Based on the GC, the oil in the trap was less "weathered" than oil in surface sediment samples. A series of high molecular weight n-alkanes with a pronounced odd-even predominance is also apparent in this sample showing input from either suspended particulate matter from the MacKenzie River or resuspended bottom sediment.

(b) Estimate of Oil in Surficial Sediments Around Minuk and Kaubvik

The data presented in Figures 14 and 17 was used to estimate the amount of base oil present in the sediments around Minuk and Kaubvik respectively. For each location, a planimeter was used to measure the area between successive isopleths. The amount of Vista oil present in each contour interval was then calculated to be the result obtained by multiplying the area of zone times the average concentration in the zone (= (high + low) / 2) times the specific gravity of the sediment (taken as 2.5). It was assumed for the calculations that the presence of Vista base oil in the surficial sediments did not extend below the top 1 cm. By this procedure it is possible to account for approximately 11.5% of the oil discharged at Minuk (32 tonnes of 278 tonnes) and 1.2% at Kaubvik (1.65 tonnes of 143 tonnes discharged). These estimates may be high as definition of oil in Vista equivalents on the basis of isoprenoids will overestimate the actual weight of oil present. Gravimetric analysis of oiled samples indicated that the actual weight of oil in the sediment by gravimetry was always less than the amount calculated using the 10 marker isoprenoids, in some instances by a factor of 5. At Kaubvik, use of the 10 Vista marker isoprenoids will underestimate the contribution of Escaid 90 which was not quantified.

The fate of the base oil following discharge to the sea will be influenced by several factors which act to redistribute the oiled cuttings near the location where they

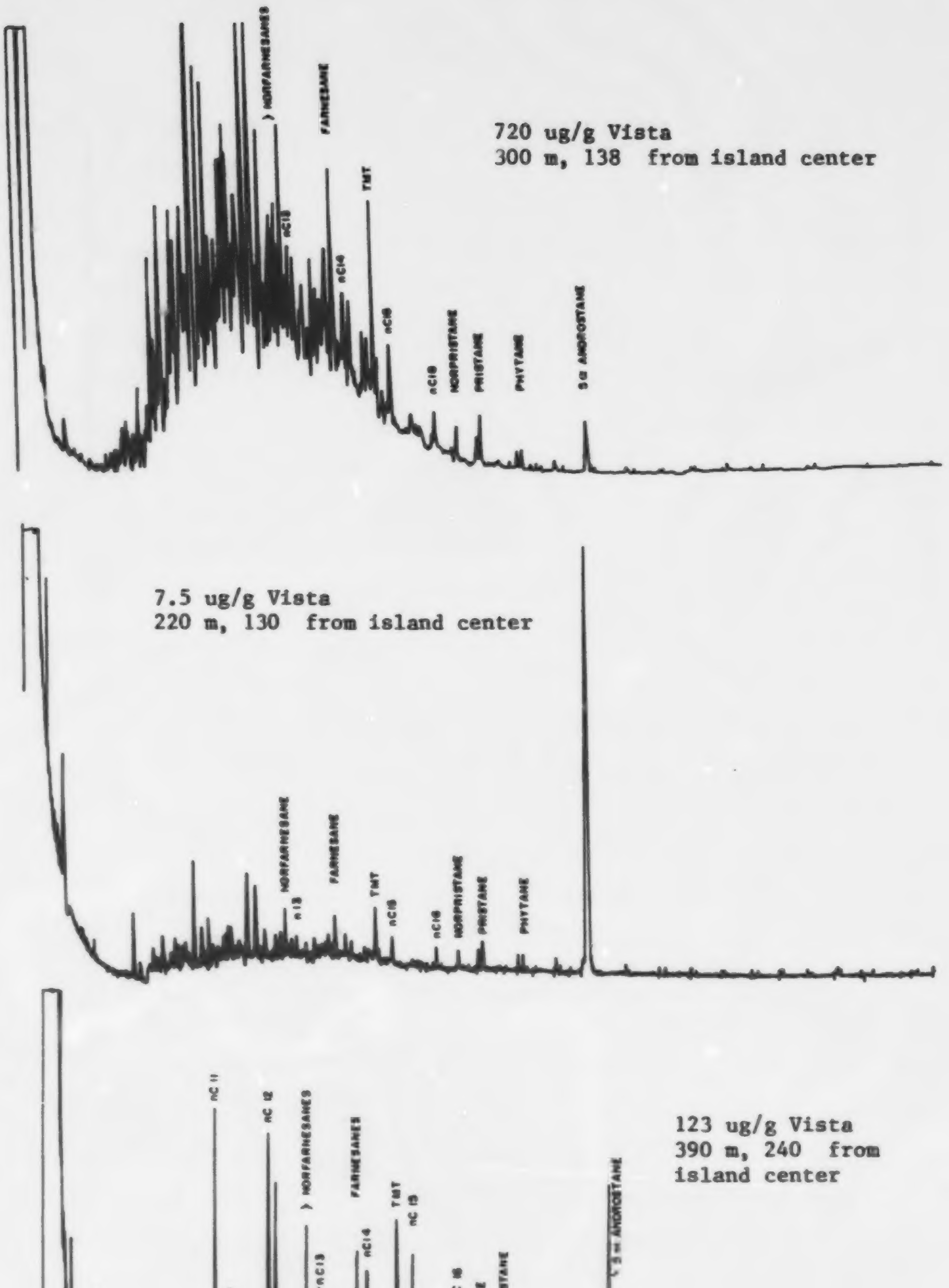


Figure 19. Gas chromatograms of aliphatic fraction of post-drilling sediment samples (series 6) containing Vista and Escaid 90 base oil at Kaubvik I-43.

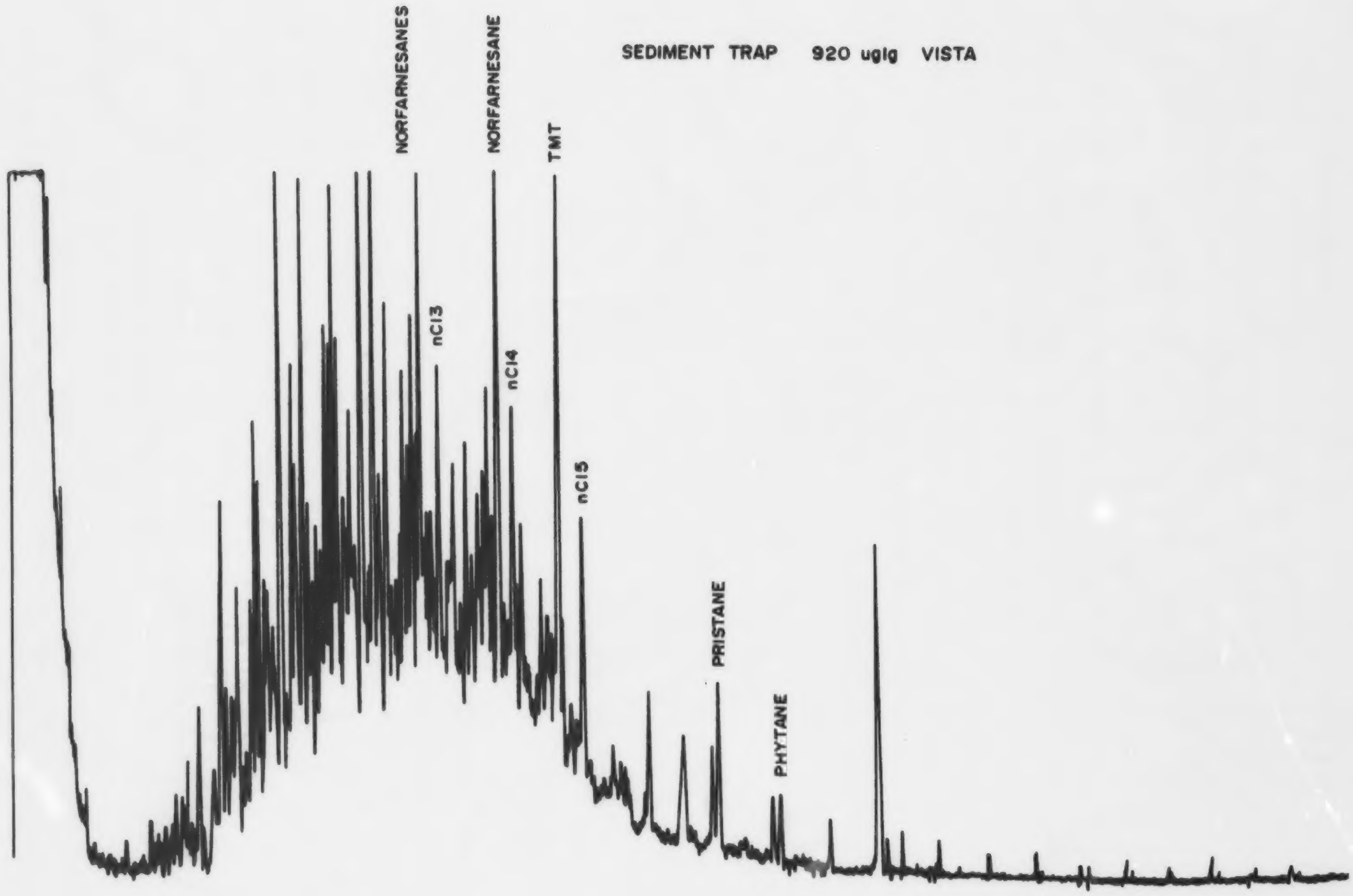


Figure 20. Gas chromatogram of the aliphatic fraction of solid material collected in a sediment trap at Kaubvik I-43 between October 10, 1986 and August 3, 1987.

were discharged or to transport and disperse the cuttings outside of the area of first contact with the sea bed.

1. Evaporation/dissolution

Following discharge of the oiled cuttings, some of the oil will evaporate and some will dissolve into sea water. As the oil will be largely bound tightly to cuttings particles and discharged to cold water the amount of oil lost by these processes will be small, probably in the order of a few percent. That oil which does evaporate or dissolve will be transported by water or air currents outside the areas shown in Figures 14 and 17.

2. Dispersion

As the cuttings are discharged to the water column, water currents will transport the particles horizontally as they settle. Experience from plume dispersion studies in the North Sea and on the Scotian Shelf strongly suggests that most of the discharged cuttings will make first contact with the seabed within several hundreds of metres of the discharge point. Only extremely fine particles with slow settling rates are likely to move beyond those distances, particularly in the shallow waters occurring at Minuk and Kaubvik. In addition, the amount of fine particles associated with the discharged cuttings is likely to be very low as oiled cuttings tend to be extremely cohesive, especially in cold water. Once on the sea bed, the oiled cuttings can be dispersed by water currents or moved/buried/resuspended by ice scouring. Long-term leaching will slowly transfer oil to the water column for transport and dilution away from the discharge area. Opposing the dispersal mechanism is the process of sedimentation which will tend to cover the oiled sediment/cuttings mixture making it more resistant to movement.

If some of the oiled cuttings at Minuk or Kaubvik were discharged to the surface of the ice adjoining the islands, then an excellent mechanism for transporting the cuttings away from the discharge point is presented. By this mechanism, any cuttings trapped on or within the ice at Minuk could be transported away from the drilling area when the grounded ice breaks free in spring and moves under the influence of wind and near surface currents. At Kaubvik, ice near the caisson was mobile during drilling and not restricted by a grounded ice rubble field. Oiled cuttings discharged to the surface of the ice could therefore have been carried away during drilling.

3. Burial near area of accumulation.

The slope of artificial islands or berms constructed to support drilling caissons are susceptible to erosion which accelerates following abandonment. The material from this process can bury nearby drill cuttings thereby isolating them from the environment.

The actual fate of the oiled cuttings discharged around Minuk and Kaubvik is largely a matter of speculation. It is likely that all mechanisms described above had some influence in placing the cuttings in a location where it could not be accounted for during the sampling programme. The relative importance of each mechanism is not known at the present time; each would, however, likely be different for the two locations.

Another possible explanation for the "unaccounted for" oil is that it resides in a cuttings pile within the study are. This is not considered too probable at Minuk because a diving survey conducted in September 1986 (series 5) could not relocate a cuttings pile in the vicinity of the position of the discharge line. The existence of a cuttings pile at Kaubvik is more likely as it was not possible to sample on the berm or near the base of the berm where most of the oiled cuttings would settle after discharge. Consequently a large portion of the discharged oil at Kaubvik could be contained in a cuttings pile on the berm. As no diving survey was conducted at Kaubvik it was not possible to investigate such a possibility.

If, in either case, a cuttings pile does exist that was undetected by the sampling programme, then a large amount of oil could be accounted for. For example, a pile 50 m x 50 m and 0.5 m thick with an average oil content of 10% would contain 100 tonnes of oil or 41% of the unaccounted for oil at Minuk and 71% of the unaccounted for oil at Kaubvik.

RELATIONSHIP OF THE DATA TO OTHER BEAUFORT SEA LOCATIONS

The data for the Minuk I-53 and Kaubvik I-43 well sites indicates the extent of dispersal that can be expected in these water depths at other Beaufort Sea locations. The results suggest that ice may enhance rather than restrict dispersal. Other discharge scenarios and different sea and ice conditions may result in different dispersal patterns. However, discharge of oiled cuttings during the open water season would mean that oiled cuttings would enter a more typical oceanic environment and be subject to the immediate effects of waves and wave induced currents. The discharge of OBDM from a drillship into deeper water would be similar to other areas such as the North Sea or offshore Nova Scotia and dispersion governed primarily by currents. The Minuk and Kaubvik results suggest that the extent and direction of dispersal will be most difficult to predict in shallower areas within the landfast and transitional ice zones where moving ice in the winter and during break-up may scour the sea-bed and transport oiled cuttings large distances.

ACKNOWLEDGEMENTS

Logistic support for all sampling was provided by Esso Resources Canada Limited. Supply vessels, the Arctic Nanabush, J. Mattson (trips 1, 2 and 4) and the Arctic Nanook (trip 5) were used for open water sampling and helicopter support and a polar bear monitor, snowmobile time and accommodation at Minuk provided for through the ice sampling.

D. Hope and R. Kashino of Seakem assisted in field sampling and current meter deployment and recovery. Assistance with sampling in April 1986 was also provided by R. Macdonald of the Institute of Ocean Sciences, Pat Bay and R. Troy of Canadian Engineering Services Ltd. R. Troy provided positioning and diving support in April 1986 sampling from the ice at Minuk.

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APPENDIX A

SUMMARY OF MINUK I-53 HYDROCARBON, GRAIN SIZE AND BARIUM DATA FOR ALL STATIONS AND SAMPLING TRIPS

Notes for summary hydrocarbon data appendices.

Data is listed in this appendix for non-polar hydrocarbon data, barium and particle size for each sample and is summarised by the stratum in which each sample station was located (see the section Methods, Sampling Design and Rational). Polycyclic aromatic hydrocarbon data is not included in this appendix and is listed in Appendix D. The mean and sample standard deviation of these parameters and various selected of hydrocarbon ratios and totals are calculated for each stratum.

Data I.D. is the identification of the sample data in the hydrocarbon lab data system.

Location: Sample locations are given as a nominal range and bearing from the island or caisson centre, except for samples from stratum 6, the reference stratum, which are referenced to the centre of the control site, circular areas 500m in diameter, 2.75km due east of the island/caisson.

The absolute location of each station, calculated as the mean of the three successful sampling sediment grabs, is also given in Universal Transverse Mercator (UTM) co-ordinates, referenced to the 135°W meridian.

Particle size: Particle size distribution is summarised as percent clay and silt, the total less than 63um, 230 standard sieve mesh size.

Depth: The mean station depth is given in meters as recorded on the sampling vessel sounder at the moment of sampling.

All concentrations are given on a dry weight basis and when a concentration is below the instumental detection limit, the detection limit in ng/g is given following the < symbol. Values at or below the detection limit are not included in the calculation of totals or ratios.

Several totals and ratios presented and are defined below.

Totals

Total non-polar hydrocarbon is the sum of resolved hydrocarbons including normal alkanes from n-C10 to n-C36 plus the total 'isoprenoid' hydrocarbons from norfarnesane to phytane plus four other non alkanes with similar retention times to norfarnesane. It should be noted that no measurements were made of the unresolved complex mixture (UCM) or 'envelope' hydrocarbons.

Total n-alkanes is the sum of normal hydrocarbons from n-C10 to n-C36.

Total isoprenoid hydrocarbon is the sum of resolved hydrocarbons from norfarnesane to phytane plus four other non alkanes with similar retention times to norfarnesane.

Non-polar H/C, nC10 to phytane is the total normal alkane fron n-C10 to n-C18 plus the isoprenoids as defined above.

Ratios

Alkanes (nC10-18)/isoprenoids is the total of n-C10 to n-C18 alkanes divided by the total isoprenoids.

Trimethyltridecane/nC15 is the ratio of the closely eluting compounds 2,6,10-trimethyl tridecane divided by n-C15.

FTN/alkane is the total of the three isoprenoids farnesane, trimethyltridecane and norpristane divided by the total n-C14,n-C15 and n-C16.

Odd-even predominance is defined as:

$$[n\text{-}C27 + [6 \times n\text{-}C29] + n\text{-}C31] / 4 \times [n\text{-}C28 + n\text{-}c30]$$

Oil Based Muds non-polar hydrocarbon data

SERIES 1: BACKGROUND SAMPLING: PRE-STORM NIMUK I-53

Sample I.D.	1-01	1-02	1-03	1-04	1-05	1-06	MEAN	S.D.
Data I.D.	314/2	315/2	316/2	343/2	317/2	344/2		
SAMPLE LOCATION								
Stratum	1	1	1	1	1	1		
Range	250	200	250	250	250	200		
Bearing	310	260	320	330	260	310		
Northing	7734161	7733933	7734198	7734235	7733972	7734167		
Easting	443289	443244	443305	443340	443185	443302		
PHYSICAL CHARACTER								
%Clay/Silt	2.8	3.5	23.5	2.4	1.4	16.3	8.3	9.3
Depth (m)	13.8	13.5	13.9	13.9	14.5	13.7	13.9	0.3
BARIUM (ug/g)	809	761	97[illegible]	764	540	894	791	149
HYDROCARBONS								
TOTALS and RATIOS[(a)]								
Total non-polar hydrocarbon	417	639	1850	551	196	2117	962	810
Total n-alkanes	364	572	1611	486	168	1804	834	693
Total isoprenoids	48	65	236	64	26	312	125	119
Non-polar H/C, nC10 to phytane	146	186	641	174	76	800	337	304
Total n-alkanes, nC10-12	16	9	23	3	4	13	11	8
alkanes (nC10-18)/isoprenoids	2.04	1.86	1.72	1.72	1.92	1.56	1.80	0.17
trimethyltridecane/nC15	0.67	0.75	0.57	0.67	0.50	0.64	0.63	0.09
FTN/alkane	0.50	0.52	0.48	0.58	0.41	0.54	0.50	0.06
Total n-alkane/total nonpolar	0.87	0.90	0.87	0.88	0.86	0.85	0.87	0.02
Odd-even predominance	4.43	6.23	3.29	2.89	4.88	2.07	3.96	1.51
nC18/phytane	1.55	1.81	1.27	2.20	1.38	1.59	1.63	0.34

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 1: BACKGROUND SAMPLING: PRE-STORM MINUK I-53 (continued)

Sample I.D.	1-01	1-02	1-03	1-04	1-05	1-06	MEAN	S.D.
Data I.D.	314/2	315/2	316/2	343/2	317/2	344/2		
H/C CONCENTRATIONS (ng/g dry weight basis)								
nC10	5	2	3	1	2	1	2	2
nC11	5	3	6	1	1	3	3	2
nC12	6	4	14	1	1	9	6	5
Norfarnesane(a)	<1	<2	<3	<1	<1	<1	2	1
(b)	<1	<2	<3	<1	<1	<1	2	1
(c)	<1	<2	<3	<1	<1	<1	2	1
(d)	<1	<2	<3	<1	<1	<1	2	1
(e)	2	<2	10	<1	<1	5	4	4
nC13	7	7	32	3	2	19	12	12
Farnesane	3	4	14	1	1	12	6	6
nC14	10	11	49	5	4	36	19	19
Trimethyl-nC13	10	15	39	8	4	43	20	17
nC15	15	20	68	12	8	67	32	28
nC16	15	21	68	16	10	93	37	35
Norpristane	7	8	36	10	4	50	19	19
nC17	18	24	89	27	11	130	50	48
Pristane	15	22	77	25	9	120	45	44
nC18	17	29	76	44	11	130	51	45
Phytane	11	16	60	20	8	82	33	31
nC19	17	18	99	49	10	130	54	50
nC20	67	<2	130	<1	26	260	81	100
nC21	15	28	86	32	8	94	44	37
nC22	12	22	75	24	6	92	39	36
nC23	22	55	100	48	12	110	58	40
nC24	11	23	64	22	5	66	32	27
nC25	23	61	100	42	10	120	59	43
nC26	8	17	53	12	3	58	25	24
nC27	27	67	150	35	13	110	67	53
nC28	7	13	46	10	2	50	21	21
nC29	25	68	130	42	10	91	61	45
nC30	4	8	31	17	2	37	17	15
nC31	18	48	82	25	5	65	41	30
nC32	2	3	13	4	1	9	5	5
nC33	7	13	34	9	2	16	14	11
nC34	2	3	5	2	1	4	3	1
nC35	2	3	6	2	2	4	3	2
nC36	2	3	5	2	2	1	3	1

Oil Based Muds non-polar hydrocarbon data

SERIES 1: BACKGROUND SAMPLING: PRE-STORM MINUK I-53 (continued)

Sample I.D.	1-07	1-08	1-09	1-10	1-11	1-12	1-13	1-14	MEAN	S.D.
Data I.D.	321/2	322/2	323/2	324/2	325/2	327/2	328/2	329/2		
SAMPLE LOCATION										
Stratum	2	2	2	2	2	2	2	2		
Range	350	450	450	400	400	400	450	450		
Bearing	290	290	230	290	250	270	220	270		
Northing	7734109	7734162	7733714	7734173	7733887	7733993	7733669	7733993		
Easting	443141	443020	443073	443076	443072	443050	443130	442996		
PHYSICAL CHARACTER										
%Clay/Silt	0.4	0.8	16.2	3.5	21.0	8.4		76.8	18.2	27.0
Depth (m)	14.6	15.3	14.7	15.0	14.9	15.4	14.6	15.3	15.0	0.3
BARIUM (ug/g)	720	762	1100	778	881	774	867	953	854	125
HYDROCARBONS										
TOTALS and RATIOS(a)										
Total non-polar hydrocarbon	217	1491	3720	1127	3122	2824	7914	7054	3434	2756
Total n-alkanes	175	1243	3210	1033	2599	2516	6735	5140	2831	2193
Total isoprenoids	40	236	490	93	510	300	1133	1868	584	621
Non-polar H/C, nC10 to phytane	101	642	1339	242	1340	820	2990	4691	1521	1567
Total n-alkanes, nC10-12	4	55	79	5	63	27	217	253	88	95
alkanes (nC10-18)/isoprenoids	1.53	1.72	1.73	1.60	1.63	1.73	1.64	1.51	1.64	0.09
trimethyltridecane/nC15	0.67	0.64	0.62	0.57	0.55	0.52	0.63	0.67	0.61	0.06
FTN/alkane	0.58	0.52	0.55	0.51	0.52	0.52	0.57	0.64	0.55	0.04
Total n-alkane/total nonpolar	0.81	0.83	0.86	0.92	0.83	0.89	0.85	0.73	0.84	0.06
Odd-even predominance	5.05	4.13	2.29	3.24	2.25	2.38	1.99	1.81	2.89	1.15
nC18/phytane	2.00	1.36	1.31	1.22	1.25	1.50	1.17	1.44	1.41	0.26

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 1: BACKGROUND SAMPLING: PRE-STORM MINUK I-53 (continued)

Sample I.D.	1-07	1-08	1-09	1-10	1-11	1-12	1-13	1-14	MEAN	S.D.
Data I.D.	321/2	322/2	323/2	324/2	325/2	327/2	328/2	329/2		
H/C CONCENTRATIONS (ng/g dry weight basis)										
nC10	2	12	20	1	13	8	46	46	19	18
nC11	1	18	23	1	20	8	72	77	28	30
nC12	1	25	36	3	30	11	99	130	42	47
Norfarnesane(a)	<0.8	<2	<2	<1	<2	<2	<2	<4	2	1
(b)	<0.8	<2	<2	<1	<2	<2	<2	<4	2	1
(c)	<0.8	7	<2	<1	7	<2	<2	44	8	15
(d)	<0.8	8	<2	<1	8	<2	<2	55	10	18
(e)	<0.8	13	19	<1	15	<2	<2	89	18	30
nC13	2	38	62	6	49	23	130	210	65	71
Farnesane	2	17	33	4	25	16	53	130	35	42
nC14	4	49	88	12	68	47	180	300	94	100
Trimethyl-nC13	6	43	87	13	61	43	170	290	89	96
nC15	9	67	140	23	110	82	270	430	141	142
nC16	11	58	120	28	130	81	290	460	147	153
Norpristane	6	31	71	15	74	51	200	340	99	115
nC17	13	75	190	42	210	140	420	650	218	216
Pristane	13	70	150	34	160	110	410	560	188	194
nC18	18	64	170	33	200	120	350	520	184	173
Phytane	9	47	130	27	160	80	300	360	139	129
nC19	8	93	160	37	200	130	320	420	171	140
nC20	<0.9	140	190	220	350	150	320	370	218	125
nC21	10	61	180	64	210	150	370	360	176	135
nC22	7	44	160	71	170	140	340	330	158	123
nC23	15	71	200	100	210	180	420	250	181	125
nC24	7	37	140	62	120	110	290	140	113	87
nC25	14	70	210	76	180	220	560	75	176	172
nC26	5	28	110	31	59	71	300	36	80	94
nC27	14	91	250	68	110	180	510	76	162	158
nC28	3	23	110	20	39	73	260	31	70	84
nC29	13	79	240	60	66	180	470	68	147	150
nC30	2	15	93	16	20	74	200	44	58	66
nC31	9	62	170	38	26	140	340	60	106	110
nC32	1	8	44	4	9	55	92	34	31	32
nC33	3	17	42	12	3	68	70	30	31	27
nC34	1	4	22	8	4	45	41	21	18	18
nC35	1	3	26	2	3	25	14	12	11	10
nC36	2	3	27	2	3	16	7	6	8	9

Oil Based Muds non-polar hydrocarbon data

SERIES 1: BACKGROUND SAMPLING: PRE-STORM MINUK I-53 (continued)

Sample I.D.	1-15	1-16	1-17	1-18	1-19	1-20	MEAN	S.D.
Data I.D.	330/2	331/2	333/2	334/2	335/2	336/2		
SAMPLE LOCATION								
Stratum	3	3	3	3	3	3		
Range	600	550	550	850	500	500		
Bearing	230	320	300	310	250	260		
Northing	7733630	7734451	7734299	7734354	7733847	7733915		
Easting	442977	443093	442961	443003	442967	442958		
PHYSICAL CHARACTER								
%Clay/Silt	55.0	53.7		31.8	19.6	49.3	41.9	15.5
Depth (m)	15.2	15.2	15.2	15.3	14.7	15.1	15.1	0.2
BARIUM (ug/g)	1140	1000	775	991	889	1030	971	125
HYDROCARBONS								
TOTALS and RATIOS$^{(a)}$								
Total non-polar hydrocarbon	10754	6073	6455	6126	4054	5445	6485	2259
Total n-alkanes	9262	4900	5602	5200	3428	4569	5494	1989
Total isoprenoids	1467	1169	816	901	595	849	966	307
Non-polar H/C, nC10 to phytane	3812	3143	2291	2414	1737	2516	2652	725
Total n-alkanes, nC10-12	145	74	155	123	144	137	130	29
alkanes (nC10-18)/isoprenoids	1.60	1.69	1.81	1.68	1.92	1.96	1.78	0.15
trimethyltridecane/nC15	0.59	0.59	0.58	0.58	0.58	0.48	0.57	0.04
FTN/alkane	0.54	0.51	0.50	0.51	0.47	0.42	0.49	0.04
Total n-alkane/total nonpolar	0.86	0.81	0.87	0.85	0.85	0.84	0.84	0.02
Odd-even predominance	2.07	3.20	2.15	2.40	2.60	1.52	2.32	0.56
nC18/phytane	1.30	1.37	1.32	1.36	1.31	1.26	1.32	0.04

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 1: BACKGROUND SAMPLING: PRE-STORM MINUK I-53 (continued)

Sample I.D.	1-15	1-16	1-17	1-18	1-19	1-20	MEAN	S.D.
Data I.D.	330/2	331/2	333/2	334/2	335/2	336/2		
N/C CONCENTRATIONS (ng/g dry weight basis)								
nC10	25	4	37	25	31	27	25	11
nC11	45	16	47	37	47	42	39	12
nC12	75	54	71	61	66	68	66	7
Norfarnesane(a)	<4	<4	<4	<4	<4	<11	5	3
(b)	<4	<4	<4	<4	<4	<11	5	3
(c)	<4	<4	22	<4	<4	<11	8	7
(d)	<4	<4	<4	<4	<4	<11	5	3
(e)	38	34	31	35	25	<11	29	10
nC13	130	120	120	110	98	140	120	15
Farnesane	59	45	63	56	44	44	52	9
nC14	200	180	170	170	130	180	172	23
Trimethyl-nC13	190	170	140	140	110	130	147	29
nC15	320	290	240	240	190	270	258	45
nC16	370	310	230	230	190	290	270	66
Norpristane	230	180	120	130	86	140	148	51
nC17	620	520	310	340	220	360	395	147
Pristane	520	390	250	320	200	300	330	113
nC18	560	480	250	300	170	290	342	148
Phytane	430	350	190	220	130	230	258	111
nC19	690	430	250	260	160	260	342	192
nC20	520	410	250	270	150	240	307	134
nC21	570	420	270	280	170	230	323	146
nC22	510	350	240	240	130	180	275	137
nC23	610	350	300	290	170	210	322	155
nC24	440	210	220	180	110	120	213	120
nC25	660	260	310	290	170	160	308	183
nC26	380	100	190	150	86	81	165	114
nC27	760	200	420	390	240	180	365	218
nC28	340	57	190	160	86	86	153	104
nC29	590	100	400	380	230	190	315	177
nC30	230	6	180	150	90	170	138	79
nC31	410	6	360	310	210	240	256	143
nC32	96	6	160	100	96	170	105	59
nC33	83	6	190	130	110	170	115	66
nC34	31	6	100	65	55	120	63	42
nC35	16	6	81	43	34	77	43	31
nC36	6	7	53	24	20	45	26	19

Oil Based Muds non-polar hydrocarbon data

SERIES 1: BACKGROUND SAMPLING: PRE-STORM MINUK I-53 (continued)

Sample I.D.	1-21	1-22	1-23	1-24	1-25	1-26	1-27	1-28	MEAN	S.D.
Data I.D.	337/2	338/2	339/2	3207/1	3208/1	3201/1	341/2	342/2		
SAMPLE LOCATION										
Stratum	4	4	4	4	4	4	4	4		
Range	450	850	400	550	650	900	250	900		
Bearing	10	170	0	160	20	330	0	0		
Northing	7734442	7733190	7734406	7733490	7734617	7734805	7734244	7734917		
Easting	443464	443610	443410	443610	443659	442979	443463	443435		
PHYSICAL CHARACTER										
%Clay/Silt	91.2	98.1	49.1	59.2	59.2	98.1	0.1		65.0	35.1
Depth (m)	15.0	14.6	14.8	15.2	15.1	15.4	13.0	15.3	14.8	0.8
BARIUM (ug/g)	1030	1000	1030	1080	1040	945	808	934	983	86
HYDROCARBONS TOTALS and RATIOS[(a)]										
Total non-polar hydrocarbon	22772	16698	9363	9286	11142	17301	444	16021	12878	6812
Total n-alkanes	19874	15645	7828	7687	9703	14371	383	13348	11105	6007
Total isoprenoids	2869	1037	1473	1539	1431	2860	59	2573	1730	982
Non-polar H/C, nC10 to phytane	6832	2708	3869	3994	3596	6591	152	6713	4307	2330
Total n-alkanes, nC10-12	223	52	286	265	75	350	7	460	215	158
alkanes (nC10-18)/isoprenoids	1.38	1.61	1.63	1.60	1.51	1.30	1.58	1.61	1.53	0.12
trimethyltridecane/nC15	0.66	0.50	0.69	0.69	0.56	0.65	0.69	0.63	0.63	0.07
FTN/alkane	0.64	0.58	0.64	0.60	0.62	0.71	0.61	0.58	0.62	0.04
Total n-alkane/total nonpolar	0.87	0.94	0.84	0.83	0.87	0.83	0.86	0.83	0.86	0.04
Odd-even predominance	1.28	1.82	1.75	1.76	1.88	1.54	2.36	1.56	1.74	0.32
nC18/phytane	1.26	1.51	1.56	1.59	1.65	1.32	1.67	1.31	1.48	0.16

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 1: BACKGROUND SAMPLING: PRE-STORM MINUK I-53 (continued)

Sample I.D.	1-21	1-22	1-23	1-24	1-25	1-26	1-27	1-28	MEAN	S.D.
Data I.D.	337/2	338/2	339/2	3207/1	3208/1	3201/1	341/2	342/2		
H/C CONCENTRATIONS (ng/g dry weight basis)										
nC10	29	16	62	60	8	70	2	100	43	35
nC11	74	16	94	85	20	110	2	160	70	54
nC12	120	20	130	120	47	170	3	200	101	71
Norfarnesane(a)	<4	<3	<3	<1	<2	<3	<1	<4	3	1
(b)	<4	<3	<3	<1	<2	<3	<1	<4	3	1
(c)	47	<3	42	38	12	58	<1	57	32	23
(d)	55	<3	53	48	15	72	<1	66	39	28
(e)	97	<3	88	74	31	120	<1	130	68	51
nC13	230	50	190	200	100	31	4	350	144	118
Farnesane	140	22	110	99	63	160	3	150	93	59
nC14	370	89	250	270	180	400	6	430	249	151
Trimethyl-nC13	380	85	240	220	180	370	9	380	233	140
nC15	580	170	350	320	320	570	13	600	365	210
nC16	640	240	360	330	380	620	17	620	401	218
Norpristane	490	180	260	230	300	600	10	430	313	188
nC17	1000	540	540	560	600	930	21	920	639	317
Pristane	930	400	410	510	520	850	22	780	553	295
nC18	920	530	420	510	510	830	25	760	563	281
Phytane	730	350	270	320	310	630	15	580	401	232
nC19	1100	730	300	470	570	930	28	840	621	351
nC20	910	670	440	480	490	760	<1	740	561	279
nC21	850	710	410	380	660	720	22	900	582	292
nC22	810	730	420	370	480	680	18	550	507	251
nC23	880	820	460	400	540	760	32	600	562	274
nC24	600	680	350	270	360	520	18	440	405	207
nC25	1000	980	590	380	580	820	33	720	638	322
nC26	790	580	330	290	330	530	12	380	405	231
nC27	1100	1300	490	500	720	770	32	600	689	390
nC28	910	680	290	250	360	520	10	410	429	276
nC29	1500	1300	490	420	620	850	30	670	735	477
nC30	1300	780	250	230	300	560	15	450	486	402
nC31	1200	1500	340	350	510	780	24	740	681	484
nC32	980	770	130	150	280	470	3	410	399	335
nC33	810	730	92	190	300	520	9	340	374	291
nC34	530	500	52	82	220	240	2	230	232	196
nC35	390	300	35	49	190	180	2	190	167	135
nC36	280	230	25	31	36	100	2	98	100	102

Oil Based Muds non-polar hydrocarbon data

SERIES 1: BACKGROUND SAMPLING: PRE-STORM NINUK I-53 (continued)

Sample I.D.	1-29	1-30	1-31	1-32	1-33	1-34	MEAN	S.D.
Data I.D.	305/2	306/2	309/2	310/2	311/2	312/2		
SAMPLE LOCATION								
Stratum	6	6	6	6	6	6		
Range	500	800	800	400	750	900		
Bearing	170	110	70	100	90	50		
Northing	7733501	7733746	7734273	7733915	7734013	7734605		
Easting	445267	445940	445930	445595	445936	445875		
PHYSICAL CHARACTER								
%Clay/Silt	98.5	98.9	97.8	94.6	98.9	67.1	92.6	12.6
Depth (m)	14.1	13.8	13.6	14.2	14.0	14.4	14.0	0.3
BARIUM (ug/g)	1030	1030	1000	1100	345	1090	933	290
HYDROCARBONS								
TOTALS and RATIOS[(a)]								
Total non-polar hydrocarbon	8225	15385	14915	18865	14769	9965	13687	3900
Total n-alkanes	6415	12376	12800	15483	11916	8312	11217	3287
Total isoprenoids	1798	3005	2101	3344	2827	1626	2450	704
Non-polar H/C, nC10 to phytane	4586	7251	5511	8361	6710	4290	6118	1595
Total n-alkanes, nC10-12	88	76	130	327	193	174	165	92
alkanes (nC10-18)/isoprenoids	1.55	1.41	1.62	1.50	1.37	1.64	1.52	0.11
trimethyltridecane/nC15	0.59	0.66	0.52	0.65	0.61	0.63	0.61	0.05
FTN/alkane	0.53	0.66	0.51	0.64	0.69	0.60	0.61	0.07
Total n-alkane/total nonpolar	0.78	0.80	0.86	0.82	0.81	0.83	0.82	0.03
Odd-even predominance	1.19	1.61	1.67	1.79	1.48	1.87	1.60	0.24
nC18/phytane	1.14	1.27	1.48	1.34	1.27	1.15	1.28	0.13

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 1: BACKGROUND SAMPLING: PRE-STORM MINUK I-53 (continued)

Sample I.D.	1-29	1-30	1-31	1-32	1-33	1-34	MEAN	S.D.
Data I.D.	305/2	306/2	309/2	310/2	311/2	312/2		
H/C CONCENTRATIONS (ng/g dry weight basis)								
nC10	12	4	14	38	26	27	20	12
nC11	22	4	35	89	57	54	44	30
nC12	54	68	81	200	110	93	101	52
Norfarnesane(a)	<12	<4	<6	<4	<5	<3	6	3
(b)	<12	<4	<6	<4	<5	<3	6	3
(c)	12	26	15	58	<5	<3	20	20
(d)	13	37	25	76	<5	<3	27	27
(e)	25	72	47	130	67	52	66	36
nC13	150	270	160	400	230	160	228	97
Farnesane	64	170	64	220	120	94	122	62
nC14	260	460	270	540	350	260	357	119
Trimethyl-nC13	290	450	240	500	350	260	348	106
nC15	490	680	460	770	570	410	563	139
nC16	570	730	560	800	640	450	625	126
Norpristane	350	610	350	630	610	320	478	152
nC17	730	1100	970	1200	970	680	942	203
Pristane	600	910	780	1000	950	440	780	220
nC18	500	930	860	980	930	530	788	215
Phytane	440	730	580	730	730	460	612	138
nC19	470	710	1000	1100	790	670	790	230
nC20	370	810	870	760	750	450	668	206
nC21	320	740	810	800	790	500	660	203
nC22	200	750	770	840	740	480	630	244
nC23	180	730	790	850	770	490	635	255
nC24	85	580	600	580	580	320	458	211
nC25	90	920	880	970	870	520	708	343
nC26	36	520	470	610	450	320	401	202
nC27	95	650	760	1100	550	550	618	328
nC28	100	430	430	550	370	270	358	156
nC29	190	560	640	810	480	420	517	210
nC30	230	250	330	380	260	180	272	72
nC31	330	370	490	700	300	290	413	158
nC32	290	69	190	190	130	68	156	85
nC33	280	24	150	110	84	42	115	93
nC34	200	10	120	52	74	34	82	69
nC35	100	5	65	50	35	35	48	32
nC36	73	6	39	52	36	36	40	22

Oil Based Muds non-polar hydrocarbon data

SERIES 1: BACKGROUND SAMPLING: PRE-STORM MINUK I-53 (continued)

Sample I.D.	1-40	1-41	1-42	MEAN	S.D.
Data I.D.	345/2	346/2	347/2		
SAMPLE LOCATION					
Stratum	5	5	5		
Range	500	800	800		
Bearing	170	110	70		
Northing	7733565	7733695	7734306		
Easting	443584	444236	444225		
PHYSICAL CHARACTER					
%Clay/Silt	57.5	96.9	68.7	74.4	20.3
Depth (m)	14.8	14.7	14.7	14.7	0.1
BARIUM (ug/g)	1180	1125	1230	1178	53
HYDROCARBONS					
TOTALS and RATIOS(a)					
Total non-polar hydrocarbon	9160	12525	16694	12793	3774
Total n-alkanes	7802	10097	14139	10679	3208
Total isoprenoids	1335	2378	2474	2062	632
Non-polar H/C, nC10 to phytane	3440	6045	6525	5337	1660
Total n-alkanes, nC10-12	135	277	371	261	119
alkanes (nC10-18)/isoprenoids	1.58	1.54	1.64	1.59	0.05
trimethyltridecane/nC15	0.66	0.63	0.64	0.64	0.01
FTM/alkane	0.62	0.61	0.59	0.60	0.01
Total n-alkane/total nonpolar	0.85	0.81	0.85	0.83	0.03
Odd-even predominance	1.88	1.82	1.66	1.79	0.11
nC18/phytane	1.53	1.30	1.60	1.48	0.16

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 1: BACKGROUND SAMPLING: PRE-STORM MINUK I-53 (continued)

Sample I.D.	1-40	1-41	1-42	MEAN	S.D.
Data I.D.	345/2	346/2	347/2		
H/C CONCENTRATIONS (ng/g dry weight basis)					
nC10	23	50	81	51	29
nC11	42	87	120	83	39
nC12	70	140	170	127	51
Norfarnesane(a)	<2	<4	<4	3	1
(b)	<2	<4	<4	3	1
(c)	26	42	46	38	11
(d)	30	53	58	47	15
(e)	53	93	100	82	25
nC13	130	250	280	220	79
Farnesane	76	150	140	122	40
nC14	210	370	370	317	92
Trimethyl-nC13	210	360	340	303	81
nC15	320	570	530	473	134
nC16	340	590	780	570	221
Norpristane	250	420	510	393	132
nC17	510	870	890	757	214
Pristane	390	690	760	613	197
nC18	460	740	830	677	193
Phytane	300	570	520	463	144
nC19	530	600	770	633	123
nC20	370	520	660	517	145
nC21	400	590	590	527	110
nC22	330	590	620	513	159
nC23	440	560	660	553	110
nC24	330	440	480	417	78
nC25	650	700	860	737	110
nC26	31	400	520	317	255
nC27	570	630	910	703	181
nC28	290	320	520	377	125
nC29	500	470	880	617	229
nC30	240	200	540	327	186
nC31	410	330	850	530	280
nC32	180	63	450	231	198
nC33	240	44	360	215	160
nC34	110	13	220	114	104
nC35	69	5	190	88	94
nC36	30	5	89	41	43

Oil Based Muds non-polar hydrocarbon data

SERIES 3: BACKGROUND SAMPLING: POST-STORM MINUK I-53

Sample I.D.	3-06	3-07	3-07	3-34	3-35	3-36	MEAN	S.D.
Data I.D.	827/7	822/7	449/2	972/5	837/7	973/5		
SAMPLE LOCATION								
Stratum	1	1	1	1	1	1		
Range	250	350	350	200				
Bearing	230	210	210	270				
Northing	7733820	7733720	7733720	7734010	7734050			
Easting	443305	443400	443400	443315	443345			
PHYSICAL CHARACTER								
%Clay/Silt	1.6	52.2	52.2	12.2	0.0		23.6	26.5
Depth (m)	14.3	14.6	14.6	7.3			12.7	3.6
BARIUM (ug/g)	1540	669		1040		1100	1087	357
HYDROCARBONS								
TOTALS and RATIOS(a)								
Total non-polar hydrocarbon	150.1	5328	5344	545	17.4	1087	2079	2550
Total n-alkanes	121.6	4691	4755	438	13.6	937	1826	2267
Total isoprenoids	28	637	571	107	3.4	150	249	280
Non-polar H/C, nC10 to phytane	91.7	1860	1622	391	8.9	443	736	800
Total n-alkanes, nC10-12	1.5	15	196	47	1.6	0	44	77
alkanes (nC10-18)/isoprenoids	2.28	1.92	1.84	2.65	1.62	1.95	2.04	0.37
trimethyltridecane/nC15	0.17	0.46	0.43	0.33	0.50	0.29	0.36	0.12
FTN/alkane	0.57	0.48	0.55	0.40	0.56	0.46	0.50	0.07
Total n-alkane/total nonpolar	0.81	0.88	0.89	0.80	0.78	0.86	0.84	0.05
Odd-even predominance	3.15	1.90	2.22	n/a	1.00	3.66	1.99	1.35
nC18/phytane	4.33	1.43	1.55	1.57	2.67	2.05	2.27	1.11

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 3: BACKGROUND SAMPLING: POST-STORM MINUK I-53

Sample I.D.	3-06	3-07	3-07	3-34	3-35	3-36	MEAN	S.D.
Data I.D.	827/7	822/7	449/2	972/5	837/7	973/5		
H/C CONCENTRATIONS (ng/g dry weight basis)								
nC10	<0.5	<3	18	<3	<0.4	0	4	7
nC11	<0.5	<3	160	22	0.6	0	31	64
nC12	<0.5	15	18	25	0.6	0	10	11
Norfarnesane(a)	<0.5	<3	0	<3	<0.3	<3	2	2
(b)	<0.5	<3	0	<3	<0.3	<3	2	2
(c)	<0.5	<3	0	<3	<0.3	<3	2	2
(d)	<0.5	<3	0	<3	<0.3	<3	2	2
(e)	<0.5	<3	0	4	<0.3	<3	2	2
nC13	<0.5	36	17	31	0.6	0	14	16
Farnesane	<0.5	18	16	10	<0.3	0	7	8
nC14	0.7	72	24	36	0.4	0	22	29
Trimethyl-nC13	1	69	32	14	<0.3	15	22	26
nC15	6	150	74	42	0.6	51	54	55
nC16	10	210	140	37	0.6	58	76	82
Norpristane	8	120	83	22	<0.3	35	45	47
nC17	19	440	290	55	0.9	100	151	176
Pristane	10	220	240	34	0.7	59	94	107
nC18	26	300	310	36	0.8	84	126	141
Phytane	6	210	200	23	<0.3	41	80	98
nC19	13	400	350	34	0.7	80	146	180
nC20	0	250	370	0	0	0	103	165
nC21	7	330	330	16	0.6	75	126	160
nC22	5	300	300	11	0.4	61	113	147
nC23	4	330	340	13	0.5	70	126	164
nC24	3	230	210	10	<0.4	46	83	107
nC25	4	320	310	12	<0.4	68	119	154
nC26	2	180	170	8	<0.5	23	64	86
nC27	8	370	320	18	<0.5	81	133	167
nC28	2	170	120	6	<0.5	21	53	73
nC29	4	260	330	14	<0.5	59	111	146
nC30	<0.7	100	160	<4	<0.5	11	46	68
nC31	2	120	190	12	<0.5	33	60	78
nC32	<0.7	26	93	<4	<0.5	<5	22	36
nC33	<0.7	49	58	<4	<0.5	16	21	26
nC34	<0.7	33	36	<4	<0.5	<5	13	17
nC35	<0.8	<5	35	<4	<0.5	<5	8	13
nC36	<0.8	<5	<8	<4	<0.5	<5	4	3

Oil Based Muds non-polar hydrocarbon data

SERIES 3: BACKGROUND SAMPLING: POST-STORM MINUK I-53 (continued)

Sample I.D.	3-01	3-03	3-04	3-08	3-09	3-12	MEAN	S.D.
Data I.D.	974/5	832/7	826/7	824/7	828/7	833/7		
SAMPLE LOCATION								
Stratum	2	2	2	2	2	2		
Range	250	250	300	450	400	500		
Bearing	310	270	250	250	260	290		
Northing	7734262	7734070	7733880	7733900	7733975	7734170		
Easting	443210	443184	443170	443100	443110	443170		
PHYSICAL CHARACTER								
%Clay/Silt	46.6	0.0	1.4	0.2	15.1	16.5	13.3	18.0
Depth (m)	14.0	14.0	14.0	14.9	14.6	14.5	14.3	0.4
BARIUM (ug/g)	684	1740	856	674	719	595	878	431
HYDROCARBONS								
TOTALS and RATIOS[(a)]								
Total non-polar hydrocarbon	6026	38	289.9	45	2172	4243	2136	2520
Total n-alkanes	5306	35	242.9	42	1963	3509	1850	2184
Total isoprenoids	720	3	47	3	209	734	286	350
Non-polar H/C, nC10 to phytane	2477	13	144	18	662	2302	936	1152
Total n-alkanes, nC10-12	177	0	1	0	36	138	59	79
alkanes (nC10-18)/isoprenoids	2.44	3.33	2.06	5.00	2.17	2.14	2.86	1.15
trimethyltridecane/nC15	0.41	n/a	0.54	0.00	0.52	0.57	0.41	0.24
FTN/alkane	0.42	n/a	0.56	0.00	0.48	0.50	0.39	0.22
Total n-alkane/total nonpolar	0.88	0.92	0.84	0.93	0.90	0.83	0.88	0.04
Odd-even predominance	1.49	n/a	4.54	n/a	1.30	2.04	2.34	1.50
nC18/phytane	1.93	n/a	2.40	3.00	1.53	1.37	2.05	0.67

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 3: BACKGROUND SAMPLING: POST-STORM MINUK I-53 (continued)

Sample I.D.	3-01	3-03	3-04	3-08	3-09	3-12	MEAN	S.D.
Data I.D.	974/5	832/7	826/7	824/7	828/7	833/7		
H/C CONCENTRATIONS (ng/g dry weight basis)								
nC10	<5	<0.9	<0.6	<0.9	<2	<4	2	2
nC11	77	<0.8	<0.6	<0.9	14	53	24	33
nC12	100	<0.7	1	<0.9	22	85	35	46
Norfarnesane(a)	<4	<0.7	<0.6	<0.9	<2	<4	2	2
(b)	<4	<0.7	<0.6	<0.9	<2	<4	2	2
(c)	<4	<0.7	<0.6	<0.9	<2	<4	2	2
(d)	<4	<0.7	<0.6	<0.9	<2	<4	2	2
(e)	26	<0.7	<0.6	<0.9	<2	26	9	13
nC13	140	<0.7	4	1	33	120	50	64
Farnesane	54	<0.7	3	<0.9	12	58	21	27
nC14	180	<0.7	8	1	44	160	66	83
Trimethyl-nC13	110	<0.7	7	<0.9	33	120	45	55
nC15	270	<0.7	13	4	64	210	94	117
nC16	280	<0.7	18	2	66	250	103	128
Norpristane	140	<0.7	12	<1	38	130	54	65
nC17	420	6	29	4	120	430	168	203
Pristane	240	3	15	2	67	210	90	108
nC18	290	4	24	3	90	260	112	131
Phytane	150	<0.8	10	1	59	190	68	83
nC19	260	6	18	3	91	290	111	131
nC20	170	0	0	0	48	220	73	98
nC21	200	3	15	3	94	240	93	105
nC22	160	2	14	2	78	190	74	83
nC23	170	3	13	3	91	210	82	91
nC24	110	2	9	2	62	120	51	55
nC25	160	2	14	3	91	150	70	74
nC26	66	1	5	<2	46	32	25	27
nC27	220	3	18	3	100	130	79	87
nC28	150	<1	4	0	63	31	42	59
nC29	330	2	17	3	120	93	94	126
nC30	280	<1	3	<2	120	60	78	110
nC31	360	1	7	<2	130	54	92	140
nC32	260	<1	2	<2	110	35	68	103
nC33	300	<1	6	<2	120	44	79	118
nC34	150	<1	0.9	5	72	32	43	59
nC35	120	<1	<0.8	<2	47	10	30	47
nC36	83	<1	<0.9	<3	27	<6	20	32

SERIES 3: BACKGROUND SAMPLING: POST-STORM MINUK I-53 (continued)

Sample I.D.	3-10	3-11	3-14	3-15	3-16	3-17	3-18	MEAN	S.D.
Data I.D.	829/7	830/7	820/6	839/7	840/8	834/7	819/7		
SAMPLE LOCATION									
Stratum	3	3	3	3	3	3	3		
Range	350	400	400	600	500	850	850		
Bearing	280	270	310	300	270	250	230		
Northing	7734017	7734044	7734358	7734172	7734073	7733710	7733440		
Easting	443057	443028	443085	442846	442854	442730	442880		
PHYSICAL CHARACTER									
%Clay/Silt	33.4	69.3	68.5	79.8	92.1	92.4	56.9	70.3	20.8
Depth (m)	14.7	14.9	14.5	14.6	14.5	14.4	14.4	14.6	0.2
BARIUM (ug/g)	808	785	697	650	677	715	598	704	74
HYDROCARBONS									
TOTALS and RATIOS(a)									
Total non-polar hydrocarbon	3543	7058	400	8504	9609	9185	4364	6095	3430
Total n-alkanes	2845	5946	351	6852	7266	7417	3685	4909	2684
Total isoprenoids	653	1075	49	1652	2343	1693	642	1158	784
Non-polar H/C, nC10 to phytane	2045	3592	169	5073	6843	5468	2231	3632	2318
Total n-alkanes, nC10-12	212	237	9	151	310	405	219	220	124
alkanes (nC10-18)/isoprenoids	2.13	2.34	2.45	2.07	1.92	2.23	2.48	2.23	0.20
trimethyltridecane/nC15	0.48	0.47	0.43	0.45	0.47	0.53	0.45	0.47	0.03
FTN/alkane	0.45	0.46	0.29	0.42	0.45	0.47	0.41	0.42	0.06
Total n-alkane/total nonpolar	0.80	0.84	0.88	0.81	0.76	0.81	0.84	0.82	0.04
Odd-even predominance	1.33	1.78	n/a	3.43	4.10	1.76	2.43	2.12	1.36
nC18/phytane	2.20	2.24	1.00	1.92	1.68	2.27	2.08	1.91	0.45

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 3: BACKGROUND SAMPLING: POST-STORM MINUK I-53 (continued)

Sample I.D.	3-10	3-11	3-14	3-15	3-16	3-17	3-18	MEAN	S.D.
Data I.D.	829/7	830/7	820/6	839/7	840/8	834/7	819/7		
H/C CONCENTRATIONS (ng/g dry weight basis)									
nC10	45	37	<4	<3	<5	75	37	29	27
nC11	67	80	<4	53	110	130	72	74	41
nC12	100	120	9	98	200	200	110	120	66
Norfarnesane(a)	34	<3	<4	23	45	61	<2	25	23
(b)	15	<3	<4	8	17	26	<2	11	9
(c)	29	18	<4	20	41	56	16	26	17
(d)	24	<3	<4	14	<4	51	<2	15	18
(e)	34	56	<4	30	100	99	45	53	36
nC13	120	170	12	180	330	350	140	186	119
Farnesane	47	71	<4	77	170	110	51	76	53
nC14	160	250	15	310	490	430	180	262	164
Trimethyl-nC13	100	170	9	230	370	280	100	180	123
nC15	210	360	21	510	790	530	220	377	255
nC16	200	400	20	650	840	620	260	427	290
Norpristane	110	220	7	310	410	350	120	218	146
nC17	270	630	31	910	1000	850	320	573	371
Pristane	160	330	21	570	750	400	190	346	252
nC18	220	470	12	710	740	590	250	427	275
Phytane	100	210	12	370	440	260	120	216	153
nC19	190	470	27	580	690	540	220	388	243
nC20	0	390	0	360	400	360	0	216	202
nC21	130	370	17	340	330	380	210	254	139
nC22	94	300	15	290	260	280	170	201	111
nC23	100	320	18	320	260	320	210	221	120
nC24	68	220	13	210	160	230	150	150	82
nC25	88	280	20	290	200	290	220	198	106
nC26	40	160	12	160	76	160	110	103	62
nC27	97	310	30	350	190	350	270	228	127
nC28	67	150	9	80	43	160	120	90	56
nC29	110	210	26	220	110	240	210	161	80
nC30	98	83	<4	49	11	110	49	58	41
nC31	120	92	24	100	36	110	110	85	38
nC32	88	24	<4	22	<7	40	20	29	28
nC33	98	44	20	43	<7	63	49	46	29
nC34	52	35	<5	17	<7	50	15	26	20
nC35	35	8	<6	<4	<7	26	<4	13	12
nC36	23	<4	<7	<5	<7	8	<5	8	7

SERIES 3: BACKGROUND SAMPLING: POST-STORM MINUK I-53 (continued)

Sample I.D.	3-19	3-20	3-20	3-22	3-23	3-25	3-26	MEAN	S.D.
Data I.D.	960/6	835/7	446/2	961/6	962/6	964/5	836/7		
SAMPLE LOCATION									
Stratum	4	4	4	4	4	4	4		
Range	900	700	700	400	450	800	900		
Bearing	340	0	0	20	160	180	200		
Northing	7734810	7734730	7734730	7734370	7733570	7733170	7733190		
Easting	443370	443620	443620	443760	443745	443610	443305		
PHYSICAL CHARACTER									
%Clay/Silt	99.1	0.8	57.1	1.7	33.0	85.6	98.6	53.7	42.9
Depth (m)	15.5	15.2	15.2	14.8	14.6	14.6	13.7	14.8	0.6
BARIUM (ug/g)	630	818		1510	643	672	575	808	353
HYDROCARBONS									
TOTALS and RATIOS[(a)]									
Total non-polar hydrocarbon	12454	5144	10835	211	2840	8101	8540	6875	4374
Total n-alkanes	7398	4319	9537	164	2407	6942	7160	5418	3269
Total isoprenoids	5030	825	1275	47	433	1159	1336	1444	1650
Non-polar H/C, nC10 to phytane	8936	2457	3818	123	1383	3932	4755	3629	2836
Total n-alkanes, nC10-12	306	26	373	11	59	173	289	177	148
alkanes (nC10-18)/isoprenoids	0.78	1.98	1.99	1.62	2.19	2.39	2.56	1.93	0.59
trimethyltridecane/nC15	0.48	0.44	0.63	1.82	0.44	0.42	0.38	0.66	0.52
FTN/alkane	2.33	0.46	0.57	0.97	0.43	0.44	0.39	0.80	0.71
Total n-alkane/total nonpolar	0.59	0.84	0.88	0.78	0.85	0.86	0.84	0.80	0.10
Odd-even predominance	2.85	2.93	1.67	n/a	3.36	2.15	2.43	2.20	1.12
nC18/phytane	1.70	1.41	1.55	1.40	1.64	2.43	1.59	1.67	0.35

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 3: BACKGROUND SAMPLING: POST-STORM MINUK I-53 (continued)

Sample I.D.	3-19	3-20	3-20	3-22	3-23	3-25	3-26	MEAN	S.D.
Data I.D.	960/6	835/7	446/2	961/6	962/6	964/5	836/7		
H/C CONCENTRATIONS (ng/g dry weight basis)									
nC10	26	<6	23	<2	<10	<7	44	17	15
nC11	110	<5	290	5	20	63	95	84	100
nC12	170	26	60	6	39	110	150	80	64
Norfarnesane(a)	<4	<5	0	<2	<8	<5	<4	4	3
(b)	<4	<5	0	<2	<8	<5	<4	4	3
(c)	29	<5	0	<2	<8	20	<4	10	11
(d)	<4	<5	0	<2	<8	<5	<4	4	3
(e)	81	<5	0	<2	<8	67	43	29	34
nC13	280	76	120	9	65	190	230	139	98
Farnesane	110	45	65	6	20	92	93	62	40
nC14	410	140	220	10	96	280	350	215	143
Trimethyl-nC13	310	120	190	20	66	190	200	157	96
nC15	640	270	300	11	150	450	520	334	218
nC16	630	300	360	11	160	470	600	362	227
Norpristane	3500	160	250	5	87	250	280	647	1262
nC17	960	510	580	17	240	700	920	561	344
Pristane	600	280	390	11	150	330	400	309	189
nC18	680	310	590	7	180	510	510	398	241
Phytane	400	220	380	5	110	210	320	235	144
nC19	640	350	480	13	160	460	560	380	224
nC20	410	290	610	11	120	370	430	320	201
nC21	420	290	560	8	140	400	490	330	197
nC22	290	240	510	6	120	350	360	268	166
nC23	320	260	560	9	150	390	410	300	181
nC24	210	170	370	5	100	290	240	198	121
nC25	270	240	570	12	150	380	340	280	177
nC26	160	110	370	3	54	220	160	154	120
nC27	300	270	590	10	130	440	330	296	191
nC28	99	60	370	<2	43	180	110	123	122
nC29	190	190	630	7	120	320	190	235	198
nC30	35	67	340	<2	27	110	48	90	115
nC31	90	80	360	4	91	130	67	117	113
nC32	26	25	320	<2	18	26	12	61	114
nC33	39	30	230	<2	34	66	28	61	77
nC34	19	15	88	<2	<13	37	10	26	29
nC35	<7	<8	35	<2	<13	<11	<7	12	11
nC36	<7	<8	24	<3	<13	<11	<7	10	7

SERIES 3: BACKGROUND SAMPLING: POST-STORM MINUK I-53 (continued)

Sample I.D.	3-28	3-29	MEAN	S.D.
Data I.D.	965/5	966/5		
SAMPLE LOCATION				
Stratum	5	5		
Range	450	700		
Bearing	90	70		
Northing	7733980	7734330		
Easting	443990	444295		
PHYSICAL CHARACTER				
%Clay/Silt	18.2	88.4	53.3	49.6
Depth (m)	15.5	14.5	15	0.7
BARIUM (ug/g)	1320	833	1076	344
HYDROCARBONS				
TOTALS and RATIOS[(a)]				
Total non-polar hydrocarbon	1256	11769	6513	7434
Total n-alkanes	1184	9959	5572	6205
Total isoprenoids	72	1810	941	1229
Non-polar H/C, nC10 to phytane	396	7010	3703	4677
Total n-alkanes, nC10-12	0	910	455	643
alkanes (nC10-18)/isoprenoids	4.50	2.87	3.69	1.15
trimethyltridecane/nC15	0.00	0.46	0.23	0.33
FTN/alkane	0.00	0.42	0.21	0.30
Total n-alkane/total nonpolar	0.94	0.85	0.89	0.07
Odd-even predominance	n/a	2.85	1.43	2.02
nC18/phytane	2.04	1.55	1.80	0.35

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 3: BACKGROUND SAMPLING: POST-STORM MINUK I-53 (continued)

Sample I.D.	3-28	3-29	MEAN	S.D.
Data I.D.	965/5	966/5		
H/C CONCENTRATIONS (ng/g dry weight basis)				
nC10	<25	<44	35	13
nC11	<22	400	211	267
nC12	<20	510	265	346
Norfarnesane(a)	<20	<35	28	11
(b)	<20	<35	28	11
(c)	<20	<35	28	11
(d)	<20	<35	28	11
(e)	<20	<35	28	11
nC13	36	610	323	406
Farnesane	<19	180	100	1[illegible]4
nC14	46	670	358	441
Trimethyl-nC13	<19	360	190	241
nC15	66	780	423	505
nC16	71	670	371	424
Norpristane	<19	360	190	241
nC17	56	970	513	646
Pristane	48	530	289	341
nC18	49	590	320	383
Phytane	24	380	202	252
nC19	38	550	294	362
nC20	50	340	195	205
nC21	540	500	520	28
nC22	40	460	250	297
nC23	49	520	285	333
nC24	34	210	122	124
nC25	49	300	175	177
nC26	<32	190	111	112
nC27	60	660	360	424
nC28	<35	160	98	88
nC29	<36	350	193	222
nC30	<38	110	74	51
nC31	<38	320	179	199
nC32	<39	<70	55	22
nC33	<39	89	64	35
nC34	<40	<71	56	22
nC35	<40	<72	56	23
nC36	<41	<74	58	23

Oil Based Muds non-polar hydrocarbon data

SERIES 3: BACKGROUND SAMPLING: POST-STORM MINUK I-53 (continued)

Sample I.D.	3-30	3-31	3-32	3-33	MEAN	S.D.
Data I.D.	967/5	968/5	970/5	971/5		
SAMPLE LOCATION						
Stratum	6	6	6	6		
Range	200	100	220	400		
Bearing	0	90	150	300		
Northing	7734160	7734000	7733710	7734280		
Easting	445250	445480	445090	445010		
PHYSICAL CHARACTER						
%Clay/Silt	94.4	96.9	98.2	91.7	95.3	2.9
Depth (m)	14.0	14.0	14.6	14.3	14.23	0.3
BARIUM (ug/g)	991	972	913	1620	1124	332
HYDROCARBONS						
TOTALS and RATIOS[(a)]						
Total non-polar hydrocarbon	5725	10739	16690	10811	10991	4483
Total n-alkanes	4758	8646	12031	8811	8562	2976
Total isoprenoids	913	2093	4099	2000	2276	1328
Non-polar H/C, nC10 to phytane	3085	7393	13899	6220	7649	4546
Total n-alkanes, nC10-12	252	870	2400	290	953	1005
alkanes (nC10-18)/isoprenoids	2.38	2.53	2.39	2.11	2.35	0.18
trimethyltridecane/nC15	0.55	0.56	0.53	0.54	0.54	0.01
FTN/alkane	0.48	0.44	0.46	0.49	0.47	0.02
Total n-alkane/total nonpolar	0.83	0.81	0.72	0.82	0.79	0.05
Odd-even predominance	3.26	n/a	n/a	2.60	1.46	1.71
nC18/phytane	2.18	2.23	1.40	1.51	1.83	0.43

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 3: BACKGROUND SAMPLING: POST-STORM MINUK I-53 (continued)

Sample I.D.	3-30	3-31	3-32	3-33	MEAN	S.D.
Data I.D.	967/5	968/5	970/5	971/5		
H/C CONCENTRATIONS (ng/g dry weight basis)						
nC10	54	<26	560	<25	166	263
nC11	88	400	840	120	362	348
nC12	110	470	1000	170	438	407
Norfarnesane(a)	<4	<21	59	<22	27	23
(b)	<4	<21	40	<22	22	15
(c)	14	63	170	<22	67	72
(d)	<4	<21	150	<22	49	68
(e)	44	180	260	30	129	111
nC13	150	580	1200	280	553	468
Farnesane	55	120	430	110	179	170
nC14	200	660	1300	420	645	475
Trimethyl-nC13	170	470	900	340	470	312
nC15	310	840	1700	630	870	595
nC16	330	660	1300	660	738	406
Norpristane	180	360	650	390	395	194
nC17	560	1000	1200	1200	990	302
Pristane	280	590	940	640	613	270
nC18	370	690	700	740	625	171
Phytane	170	310	500	490	368	158
nC19	350	570	630	700	563	151
nC20	0	350	400	420	293	197
nC21	300	450	420	570	435	111
nC22	240	340	290	460	333	94
nC23	250	360	270	500	345	114
nC24	190	140	120	320	193	90
nC25	250	310	150	450	290	125
nC26	87	100	74	130	98	24
nC27	310	270	180	470	308	121
nC28	76	96	53	110	84	25
nC29	250	210	120	190	193	54
nC30	73	<40	<31	58	51	19
nC31	130	150	84	140	126	29
nC32	23	<42	<31	<34	33	8
nC33	62	<42	<31	73	52	19
nC34	49	<42	<31	<34	39	8
nC35	<9	<43	<31	<34	29	14
nC36	<9	<44	<32	<35	30	15

Oil Based Muds non-polar hydrocarbon data

SERIES 4: POST DRILLING SAMPLING, APRIL 1986; MINUK I-53

Sample I.D.	4-40	4-41	MEAN	S.D.
Data I.D.	417/2	418/2		
SAMPLE LOCATION				
Stratum	1	1		
Range	210	230		
Bearing	210	240		
Northing	7733825	7733892		
Easting	443395	443301		
PHYSICAL CHARACTER				
%Clay/Silt	1.4	2.3	1.9	1.8
Depth (m)				
BARIUM (ug/g)	2950	11900	7425	6329
HYDROCARBONS				
TOTALS and RATIOS(a)				
Total non-polar hydrocarbon	438	423	430	10
Total n-alkanes	386	381	383	3
Total isoprenoids	46	35	40	7
Non-polar H/C, nC10 to phytane	186	194	190	6
Total n-alkanes, nC10-12	75	119	97	31
alkanes (nC10-18)/isoprenoids	3.07	4.54	3.81	1.04
trimethyltridecane/nC15	0.33	0.40	0.37	0.05
FTN/alkane	0.64	0.50	0.57	0.10
Total n-alkane/total nonpolar	0.88	0.90	0.89	0.01
Odd-even predominance	1.16	4.03	2.59	2.03
nC18/phytane	1.53	0.92	1.23	0.43

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 4: POST DRILLING SAMPLING, APRIL 1986; MINUK I-53

Sample I.D.	4-40	4-41	MEAN	S.D.
Data I.D.	417/2	418/2		
H/C CONCENTRATIONS (ng/g dry weight basis)				
nC10 d22				
nC10	6	7	7	2
nC11	68	110	89	73
nC12	1	2	2	2
Norfarnesane(a)	<0.2	<2	1	3
(b)	<0.2	<2	1	3
(c)	<0.2	<2	1	3
(d)	<0.2	<2	1	3
(e)	<0.2	<2	1	4
nC13	0.9	2	1	2
Farnesane	0.6	<2	1	3
nC14	2	2	2	0
Trimethyl-nC13	2	2	2	0
nC15	6	5	6	2
nC16	7	7	7	0
Norpristane	7	5	6	4
nC17	23	12	18	23
Pristane	19	15	17	8
nC18	26	12	19	30
Phytane	17	13	15	8
nC19	24	14	19	21
nC20	78	54	66	51
nC21	16	17	17	2
nC22	15	14	15	2
nC23	26	20	23	13
nC24	16	13	15	6
nC25	18	24	21	13
nC26	8	9	9	2
nC27	15	28	22	28
nC28	7	6	7	2
nC29	9	18	14	19
nC30	9	3	6	13
nC31	5	9	7	8
nC32	5	<3	4	4
nC33	0.7	<3	2	5
nC34	0.3	<3	2	6
nC35	<0.3	<3	2	6
nC36	<0.3	<3	2	6

Oil Based Muds non-polar hydrocarbon data

SERIES 4: POST DRILLING SAMPLING, APRIL 1986; MINUK I-53 (continued)

Sample I.D.	4-01	4-03	4-05	4-05	4-06	4-08	4-42	4-42	MEAN	S.D.
Data I.D.	441/2	400/2	447/2	402/2	403/2	424/2	448/2	419/2		
SAMPLE LOCATION										
Stratum	2	2	2	2	2	2	2	2		
Range	244	450	375	375	425	450	350	350		
Bearing	207	270	250	260	250	215	270	270		
Northing	7733790	7734007	7733879	7733942	7733862	7733638	7734007	7734007		
Easting	443389	443050	443148	443131	443101	443242	443150	443150		
PHYSICAL CHARACTER										
%Clay/Silt	76.0	42.0	12.7	12.7	18.3	67.3	16.4	16.4	32.7	73.3
Depth (m)										
BARIUM (ug/g)	4440	4670	6470		8070	3800	6370		5637	1606
HYDROCARBONS										
TOTALS and RATIOS(a)										
Total non-polar hydrocarbon	4544	7273	3452	10960	4442	8215	2854	383	5265	3366
Total n-alkanes	3895	6170	3112	10571	4073	6455	2555	346	4647	3089
Total isoprenoids	633	1072	330	371	362	1560	282	31	580	500
Non-polar H/C, nC10 to phytane	1949	2974	1084	990	918	5280	971	172	1792	1639
Total n-alkanes, nC10-12	335	133	234	37	30	1280	253	106	301	410
alkanes (nC10-18)/isoprenoids	2.08	1.77	2.28	1.67	1.54	2.38	2.44	4.55	2.34	0.95
trimethyltridecane/nC15	0.60	0.52	0.54	0.40	0.50	0.69	0.58	0.50	0.54	0.09
FTN/alkane	0.51	0.45	0.54	0.39	0.48	0.47	0.52	0.50	0.48	0.05
Total n-alkane/total nonpolar	0.86	0.85	0.90	0.96	0.92	0.79	0.90	0.90	0.88	0.05
Odd-even predominance	3.18	2.98	2.51	1.39	3.29	3.71	3.11	3.61	2.97	0.74
nC18/phytane	1.44	1.30	1.46	1.08	1.27	1.21	1.28	0.83	1.24	0.20

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 4: POST DRILLING SAMPLING, APRIL 1986; MINUK I-53 (continued)

Sample I.D.	4-01	4-03	4-05	4-05	4-06	4-08	4-42	4-42	MEAN	S.D.
Data I.D.	441/2	400/2	447/2	402/2	403/2	424/2	448/2	419/2		
H/C CONCENTRATIONS (ng/g dry weight basis)										
nC10	16	31	10	18	7	200	17	6	38	161
nC11	310	42	210	9	9	780	220	98	210	626
nC12	9	60	14	10	14	300	16	2	53	248
norfarnesane(a)	<5	<7	0	<6	<8	<11	0	<2	5	10
(b)	<5	<7	0	<6	<8	<11	0	<2	5	10
(c)	<5	<7	0	<6	<8	30	0	<2	7	24
(d)	<5	<7	0	<6	<8	80	0	<2	14	72
(e)	<5	<7	0	<6	<8	140	0	<2	21	136
nC13	41	99	25	16	24	400	22	2	79	399
Farnesane	23	42	14	11	10	130	15	<2	31	125
nC14	90	160	48	38	42	440	39	2	107	427
Trimethyl-nC13	90	140	43	31	35	290	37	2	84	281
nC15	150	270	79	78	70	420	64	4	142	412
nC16	180	310	98	170	100	390	81	6	167	381
Norpristane	100	150	64	69	57	170	44	4	82	166
nC17	260	500	140	150	150	440	120	11	221	505
Pristane	240	410	120	140	150	430	100	13	200	448
nC18	260	430	130	130	140	350	110	10	195	419
Phytane	180	330	89	120	110	290	86	12	152	325
nC19	250	370	150	170	170	380	140	13	205	370
nC20	440	470	250	280	280	420	210	49	300	420
nC21	230	350	160	210	200	340	140	16	206	324
nC22	150	270	150	240	170	240	110	13	168	251
nC23	200	360	210	460	260	290	160	19	245	398
nC24	120	230	120	680	160	180	99	12	200	612
nC25	200	360	200	1100	300	240	170	22	324	986
nC26	100	200	110	950	150	130	85	8	217	904
nC27	260	480	240	980	430	270	230	26	365	852
nC28	81	160	78	610	120	54	58	6	146	579
nC29	240	430	250	860	420	160	170	16	318	774
nC30	65	120	110	640	130	35	52	3	144	615
nC31	160	280	150	820	340	89	120	8	246	763
nC32	55	82	76	590	110	25	38	<3	122	576
nC33	10	93	54	580	160	19	38	<3	120	579
nC34	20	28	20	340	45	20	30	<3	63	337
nC35	14	16	19	280	56	21	33	<3	55	277
nC36	<7	<15	21	180	23	22	<7	<3	35	178

Oil Based Muds non-polar hydrocarbon data

SERIES 4: POST DRILLING SAMPLING, APRIL 1986; MINUK I-53 (continued)

Sample I.D.	4-10	4-11	4-12	4-13	4-43	4-46	MEAN	S.D.
Data I.D.	425/2	426/2	427/2	405/2	438/2	420/2		
SAMPLE LOCATION								
Stratum	3	3	3	3	3	3		
Range	439	685	600	650	565			
Bearing	206	280	250	270	288			
Northing	7733612	7734126	7733802	7734007	7734182			
Easting	443308	442825	442936	442850	442963			
PHYSICAL CHARACTER								
%Clay/Silt	94.0	10.8	15.8	87.3	40.2		49.6	114.8
Depth (m)								
BARIUM (ug/g)	1120	4070	2170	1710	1260	2870	2200	1117
HYDROCARBONS								
TOTALS and RATIOS[(a)]								
Total non-polar hydrocarbon	5625	1584	8330	8518	3984	3061	5184	2832
Total n-alkanes	4352	1409	6791	7236	3390	2623	4300	2316
Total isoprenoids	1273	168	1530	1236	570	414	865	552
Non-polar H/C, nC10 to phytane	3496	589	3807	3263	2003	1237	2399	1320
Total n-alkanes, nC10-12	63	161	134	177	485	196	203	146
alkanes (nC10-18)/isoprenoids	1.75	2.51	1.49	1.64	2.51	1.99	1.98	0.44
trimethyltridecane/nC15	0.49	0.58	0.48	0.63	0.51	0.58	0.54	0.06
FTN/alkane	0.44	0.53	0.52	0.66	0.44	0.53	0.52	0.08
Total n-alkane/total nonpolar	0.77	0.89	0.82	0.85	0.85	0.86	0.84	0.04
Odd-even predominance	3.24	2.43	1.96	1.46	2.95	3.63	2.61	0.81
nC18/phytane	1.21	1.46	1.25	1.37	1.42	1.46	1.36	0.11

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 4: POST DRILLING SAMPLING, APRIL 1986; MINUK I-53 (continued)

Sample I.D.	4-10	4-11	4-12	4-13	4-43	4-46	MEAN	S.D.
Data I.D.	425/2	426/2	427/2	405/2	438/2	420/2		
H/C CONCENTRATIONS (ng/g dry weight basis)								
nC10	<10	7	9	46	24	24	20	36
nC11	25	150	83	54	400	160	145	332
nC12	38	4	42	77	61	12	39	68
Norfarnesane(a)	<10	<1	<2	<5	<4	<6	5	8
(b)	<10	<1	<2	<5	<4	<6	5	8
(c)	<10	<1	10	<5	<4	<6	6	9
(d)	<10	<1	12	<5	15	<6	8	14
(e)	<10	4	24	<5	30	<6	13	31
nC13	130	12	93	130	98	24	81	154
Farnesane	63	6	54	66	33	12	39	78
nC14	260	24	200	230	130	46	148	294
Trimethyl-nC13	200	23	150	200	92	45	118	230
nC15	410	40	310	320	180	77	223	442
nC16	430	45	390	340	160	110	246	483
Norpristane	220	29	260	320	80	67	163	358
nC17	530	69	600	460	210	180	342	649
Pristane	460	58	580	380	200	160	306	597
nC18	400	70	550	370	170	190	292	535
Phytane	330	48	440	270	120	130	223	446
nC19	410	76	600	450	150	220	318	603
nC20	330	99	620	500	490	550	432	567
nC21	280	89	540	470	140	200	287	547
nC22	180	70	380	380	110	140	210	410
nC23	200	90	360	410	140	160	227	386
nC24	110	56	230	260	92	86	139	253
nC25	140	87	440	640	150	110	261	678
nC26	58	45	190	420	78	55	141	440
nC27	150	110	300	370	190	120	207	317
nC28	33	35	120	360	63	25	106	388
nC29	78	94	320	480	150	77	200	496
nC30	18	40	180	210	38	18	84	261
nC31	42	56	130	84	100	42	76	106
nC32	18	19	76	79	29	13	39	91
nC33	19	18	16	45	38	8	24	43
nC34	20	7	16	47	10	<8	18	45
nC35	21	4	5	50	6	<8	16	54
nC36	22	<2	<5	<10	7	<9	9	21

Oil Based Muds non-polar hydrocarbon data

SERIES 4: POST DRILLING SAMPLING, APRIL 1986; MINUK I-53 (continued)

Sample I.D.	4-16	4-19	4-26	4-27	4-28	4-29	4-30	4-39	MEAN	S.D.
Data I.D.	406/2	408/2	412/2	414/2	415/2	428/2	429/2	442/2		
SAMPLE LOCATION										
Stratum	4	4	4	4	4	4	4	4		
Range	750	625	550	400	920	375	975	190		
Bearing	310	12	170	195	180	180	347	190		
Northing	7734489	7734618	7733465	7733621	7733087	7733632	7734957	7733820		
Easting	442925	443630	443596	443396	443500	443500	443281	443467		
PHYSICAL CHARACTER										
%Clay/Silt	61.7	94.7	39.5	34.2	57.2	21.2	95.9	10.3	51.8	89.6
Depth (m)										
BARIUM (ug/g)	2080	961	6110	6270	953	1260	3590	2110	2917	2193
HYDROCARBONS TOTALS and RATIOS(a)										
Total non-polar hydrocarbon	12690	10131	3736	2153	11920	874	11022	565	6636	5272
Total n-alkanes	10924	8778	2920	1835	9980	820	9340	456	5632	4508
Total isoprenoids	1688	1304	696	243	1903	48	1658	105	956	772
Non-polar H/C, nC10 to phytane	4346	3767	2286	1133	5026	279	4350	341	2691	1928
Total n-alkanes, nC10-12	328	193	400	507	293	158	379	78	292	142
alkanes (nC10-18)/isoprenoids	1.57	1.89	2.28	3.66	1.64	4.81	1.62	2.25	2.47	1.17
trimethyltridecane/nC15	0.63	0.51	0.56	0.63	0.62	0.25	0.54	0.52	0.53	0.12
FTN/alkane	0.57	0.46	0.45	0.45	0.59	0.38	0.61	0.51	0.50	0.08
Total n-alkane/total nonpolar	0.86	0.87	0.78	0.85	0.84	0.94	0.85	0.81	0.85	0.05
Odd-even predominance	1.55	1.89	2.19	3.94	1.77	3.31	1.50	3.68	2.48	1.00
nC18/phytane	1.16	1.36	1.79	1.35	1.65	1.39	1.22	1.47	1.42	0.21

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 4: POST DRILLING SAMPLING, APRIL 1986; MINUK I-53 (continued)

Sample I.D.	4-16	4-19	4-26	4-27	4-28	4-29	4-30	4-39	MEAN	S.D.
Data I.D.	406/2	408/2	412/2	414/2	415/2	428/2	429/2	442/2		
H/C CONCENTRATIONS (ng/g dry weight basis)										
nC10	78	49	120	75	37	6	24	4	49	98
nC11	110	52	130	380	160	150	310	73	171	282
nC12	140	92	150	52	96	2	45	1	72	140
Norfarnesane(a)	<3	<9	<3	<4	<4	<2	<3	<0.7	4	6
(b)	<3	<9	<3	<4	<4	<2	<3	<0.7	4	6
(c)	39	<9	23	8	14	<2	4	<0.7	12	32
(d)	45	<9	52	16	30	<2	9	<0.7	20	52
(e)	72	<9	61	23	57	<2	24	<0.7	31	80
nC13	210	160	170	62	170	2	93	4	109	241
Farnesane	92	64	67	20	82	2	21	2	44	109
nC14	300	230	190	55	240	3	200	9	153	343
Trimethyl-nC13	240	200	140	45	230	2	190	12	132	296
nC15	380	390	250	72	370	8	350	23	230	507
nC16	400	410	240	73	440	13	440	25	255	576
Norpristane	280	210	98	25	310	5	390	15	167	452
nC17	530	550	170	67	800	22	620	44	350	922
Pristane	480	440	160	66	690	21	520	40	302	779
nC18	510	530	170	54	810	25	610	53	345	915
Phytane	440	390	95	40	490	18	500	36	251	665
nC19	540	540	110	58	600	31	580	51	314	811
nC20	780	530	<3	310	640	98	580	<0.8	368	921
nC21	710	580	100	53	540	39	580	44	331	885
nC22	550	450	90	45	550	35	480	26	278	744
nC23	620	530	140	72	580	51	560	23	322	813
nC24	440	350	79	37	400	36	350	11	213	561
nC25	750	540	150	70	560	52	610	14	343	898
nC26	410	280	61	28	350	27	320	6	185	510
nC27	720	640	180	93	550	71	530	18	350	861
nC28	440	220	60	24	260	21	310	4	167	489
nC29	830	650	170	86	610	57	490	13	363	954
nC30	570	420	91	19	390	13	320	3	228	669
nC31	560	310	120	69	390	37	300	7	224	590
nC32	130	88	46	14	220	10	420	3	116	430
nC33	170	83	32	28	120	4	170	0.8	76	211
nC34	54	75	10	7	72	4	40	<0.8	33	94
nC35	36	78	6	7	41	4	25	<0.9	25	79
nC36	34	<16	5	<7	21	5	7	<0.9	12	33

Oil Based Muds non-polar hydrocarbon data

SERIES 4: POST DRILLING SAMPLING, APRIL 1986; MINUK I-53 (continued)

Sample I.D.	4-21	4-23	4-25	4-36	4-37	4-38	MEAN	S.D.
Data I.D.	409/2	410/2	411/2	435/2	436/2	437/2		
SAMPLE LOCATION								
Stratum	5	5	5	5	5	5		
Range	700	400	750	134	280	210		
Bearing	30	70	130	70	90	130		
Northing	7734613	7734144	7733525	7734053	7734007	7733872		
Easting	443850	443876	444075	443626	443780	443661		
PHYSICAL CHARACTER								
%Clay/Silt	32.6	4.2	97.9	4.6	3.7	4.2	24.5	106.6
Depth (m)								
BARIUM (ug/g)	1450	1530	983	1880	2250		1619	476
HYDROCARBONS								
TOTALS and RATIOS[(a)]								
Total non-polar hydrocarbon	3093	779	9802	853	1485	1260	2879	3494
Total n-alkanes	2620	722	8728	804	1390	1170	2572	3092
Total isoprenoids	447	49	1054	47	91	84	295	402
Non-polar H/C, nC10 to phytane	1225	146	2582	206	433	377	828	943
Total n-alkanes, nC10-12	109	13	58	91	206	168	108	71
alkanes (nC10-18)/isoprenoids	1.74	1.98	1.45	3.38	3.76	3.49	2.63	1.02
trimethyltridecane/nC15	0.59	0.40	0.42	0.50	0.73	0.73	0.56	0.15
FTN/alkane	0.56	0.50	0.49	0.48	0.59	0.58	0.53	0.05
Total n-alkane/total nonpolar	0.85	0.93	0.89	0.94	0.94	0.93	0.91	0.04
Odd-even predominance	1.43	1.39	1.36	2.46	3.75	3.10	2.25	1.02
nC18/phytane	1.27	2.13	1.25	1.38	1.64	1.58	1.54	0.33

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 4: POST DRILLING SAMPLING, APRIL 1986; MINUK I-53 (continued)

Sample I.D.	4-21	4-23	4-25	4-36	4-37	4-38	MEAN	S.D.
Data I.D.	409/2	410/2	411/2	435/2	436/2	437/2		
H/C CONCENTRATIONS (ng/g dry weight basis)								
nC10	26	8	20	2	4	6	11	24
nC11	35	3	19	88	200	160	84	197
nC12	48	2	19	1	2	2	12	46
Norfarnesane(a)	<1	<2	<4	<1	<2	<2	2	3
(b)	<1	<2	<4	<1	<2	<2	2	3
(c)	<1	<2	<4	<1	<2	<2	2	3
(d)	<1	<2	<4	<1	<2	<2	2	3
(e)	27	<2	<4	<1	<2	<2	6	29
nC13	68	2	43	2	5	5	21	84
Farnesane	30	2	20	1	3	3	10	37
nC14	91	4	87	5	10	10	35	127
Trimethyl-nC13	65	4	84	4	11	11	30	106
nC15	110	10	200	8	15	15	60	238
nC16	100	14	270	12	21	20	73	307
Norpristane	75	8	170	7	13	12	48	196
nC17	160	20	420	19	39	34	115	476
Pristane	140	19	420	19	36	32	111	475
nC18	140	34	450	22	46	41	122	498
Phytane	110	16	360	16	28	26	93	407
nC19	130	30	530	29	46	40	134	593
nC20	170	<2	590	<2	<3	<2	128	708
nC21	200	47	640	39	64	60	175	706
nC22	130	40	580	33	52	47	147	645
nC23	140	96	650	64	120	110	197	671
nC24	100	43	440	35	57	49	121	474
nC25	140	100	620	74	140	120	199	623
nC26	91	33	410	30	47	39	108	448
nC27	140	76	600	81	160	120	196	602
nC28	62	18	350	28	30	30	86	390
nC29	130	49	510	87	140	110	171	508
nC30	120	52	380	39	42	38	112	405
nC31	120	19	320	55	80	63	110	325
nC32	99	18	240	23	25	22	71	265
nC33	42	3	250	20	33	22	62	280
nC34	25	3	44	6	8	7	16	48
nC35	18	3	32	2	4	3	10	37
nC36	11	3	34	2	4	3	10	37

Oil Based Muds non-polar hydrocarbon data

SERIES 4: POST DRILLING SAMPLING, APRIL 1986; MINUK I-53   (continued)

Sample I.D.	4-31	4-34	4-35	MEAN	S.D.
Data I.D.	433/2	432/2	434/2		
SAMPLE LOCATION					
Stratum	6	6	6		
Range	1750	1505	1800		
Bearing	90	91	98		
Northing	7734007	7733981	7733756		
Easting	445250	445005	445282		
PHYSICAL CHARACTER					
%Clay/Silt	99.6	97.6	99.5	98.9	3.2
Depth (m)					
BARIUM (ug/g)	1080	1240	1110	1143	85
HYDROCARBONS					
TOTALS and RATIOS[(a)]					
Total non-polar hydrocarbon	9808	6421	7930	8053	1697
Total n-alkanes	8202	5315	6528	6682	1450
Total isoprenoids	1588	1094	1378	1353	248
Non-polar H/C, nC10 to phytane	4202	3027	3777	3669	595
Total n-alkanes, nC10-12	328	278	371	326	47
alkanes (nC10-18)/isoprenoids	1.65	1.77	1.74	1.72	0.06
trimethyltridecane/nC15	0.50	0.45	0.52	0.49	0.03
FTN/alkane	0.51	0.42	0.54	0.49	0.06
Total n-alkane/total nonpolar	0.84	0.83	0.82	0.83	0.01
Odd-even predominance	2.08	3.10	2.74	2.64	0.52
nC18/phytane	1.22	1.29	1.24	1.25	0.04

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 4: POST DRILLING SAMPLING, APRIL 1986; MINUK I-53 (continued)

Sample I.D.	4-31	4-34	4-35	MEAN	S.D.
Data I.D.	433/2	432/2	434/2		
H/C CONCENTRATIONS (ng/g dry weight basis)					
nC10	18	12	24	18.0	14.7
nC11	270	240	300	270.0	73.5
nC12	40	26	47	37.7	26.2
Norfarnesane(a)	<5	<12	<6	7.7	9.3
(b)	<5	<12	<6	7.7	9.3
(c)	<5	<12	<6	7.7	9.3
(d)	13	<12	<6	10.3	10.0
(e)	26	<12	34	24.0	31.5
nC13	86	55	88	76.3	55.5
Farnesane	39	24	34	32.3	22.9
nC14	180	110	160	150.0	108.2
Trimethyl-nC13	180	100	150	143.3	121.2
nC15	360	220	290	290.0	210.0
nC16	450	340	360	383.3	175.8
Norpristane	290	160	250	233.3	199.7
nC17	600	490	570	553.3	170.6
Pristane	540	470	460	490.0	130.8
nC18	610	440	560	536.7	262.1
Phytane	500	340	450	430.0	245.6
nC19	600	480	580	553.3	192.9
nC20	580	450	560	530.0	210.0
nC21	500	430	560	496.7	195.2
nC22	470	300	420	396.7	262.1
nC23	490	330	410	410.0	240.0
nC24	360	210	240	270.0	238.1
nC25	460	260	310	343.3	312.2
nC26	280	130	150	186.7	244.3
nC27	470	240	300	336.7	357.9
nC28	180	74	90	114.7	171.4
nC29	460	200	230	296.7	426.7
nC30	240	51	74	121.7	309.4
nC31	260	110	120	163.3	251.6
nC32	110	44	44	66.0	114.3
nC33	89	30	40	53.0	94.7
nC34	41	18	8	22.3	50.8
nC35	8	18	8	11.3	17.3
nC36	8	19	9	12.0	18.2

Oil Based Muds non-polar hydrocarbon data

SERIES 5: FOLLOW-UP SAMPLING AFTER ONE OPEN WATER SEASON; NIMUK I-53

Sample I.D.	5-01	5-02	5-03	5-04	5-05	5-05	5-27	MEAN	S.D.
Data I.D.	3199/1	3200/1	3210/1	3202/2	3203/2	457/3	3205/2		
SAMPLE LOCATION									
Stratum	1	1	1	1	1	1	1		
Range	150	200	200	150	200	200	200		
Bearing	280	320	270	270	220	220	170		
Northing	7733987	7734116	7733944	7733963	7733809	7733809	7733769		
Easting	443352	443403	443355	443380	443403	443403	443610		
PHYSICAL CHARACTER									
%Clay/Silt	0.2	0.0	0.0	0.5	2.6	2.6	0.6	0.9	1.2
Depth (m)							9.0	9.0	
BARIUM (ug/g)	13900	4170	96300	7460	310		130000	42023	56292
HYDROCARBONS									
TOTALS and RATIOS[(a)]									
Total non-polar hydrocarbon	13614	1295	105959	224700	11482	9023	191363	61012	89200
Total n-alkanes	3374	416	4529	68200	3182	2410	54623	13685	26742
Total isoprenoids	10240	879	101310	155300	8300	6613	136200	47107	65247
Non-polar H/C, nC10 to phytane	13522	1143	104040	224200	11418	8568	190240	60482	88915
Total n-alkanes, nC10-12	460	10	360	15200	470	0	13740	2750	6103
alkanes (nC10-18)/isoprenoids	0.32	0.30	0.03	0.44	0.38	0.30	0.40	0.29	0.14
trimethyltridecane/nC15	2.90	3.27	1.00	3.19	2.26	2.04	3.33	2.44	0.86
FTN/alkane	2.64	3.22	79.12	2.09	2.26	2.02	2.26	15.23	31.31
Total n-alkane/total nonpolar	0.25	0.32	0.04	0.30	0.28	0.27	0.29	0.24	0.10
Odd-even predominance	n/a	5.75	1.21	n/a	n/a	n/a	n/a	1.16	2.30
nC18/phytane	0.10	0.33	0.02	0.21	0.10	0.11	0.22	0.14	0.11

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 5: FOLLOW-UP SAMPLING AFTER ONE OPEN WATER SEASON; MINUK I-53

Sample I.D.	5-01	5-02	5-03	5-04	5-05	5-05	5-27	MEAN	S.D.
Data I.D.	3199/1	3200/1	3210/1	3202/2	3203/2	457/3	3205/2		
H/C CONCENTRATIONS (ng/g dry weight basis)									
nC10	<6	<0.6	120	1200	<9	<3	540	268	455
nC11	190	4	120	0	130	<3	3200	521	1184
nC12	270	6	120	14000	340	<3	10000	3534	5899
Norfarnesane(a)	420	8	8700	13000	270	83	10000	4640	5690
(b)	370	6	8300	11000	260	140	16000	5154	6585
(c)	700	12	11000	18000	490	460	8300	5566	7047
(d)	740	14	6700	15000	620	280	14000	5336	6678
(e)	1600	33	17000	26000	1200	510	31000	11049	13390
nC13	980	33	120	24000	640	500	18000	6325	10179
Farnesane	1300	86	14000	21000	1300	650	17000	7905	9059
nC14	540	35	110	12000	420	330	8700	3162	5005
Trimethyl-nC13	1800	160	110	22000	1400	1000	17000	6210	9213
nC15	620	49	110	6900	620	490	5100	1984	2801
nC16	430	45	110	6400	600	390	4800	1825	2627
Norpristane	1100	170	12000	10000	1000	790	8000	4723	5078
nC17	180	46	1800	2900	310	95	2400	1104	1226
Pristane	1500	250	16000	12000	1200	1300	9100	5907	6377
nC18	72	46	120	1500	58	150	1300	464	643
Phytane	710	140	7500	7300	560	1400	5800	3344	3359
nC19	57	13	240	230	<12	31	540	160	194
nC20	35	21	220	150	64	100	290	126	100
nC21	<5	13	170	120	<15	36	130	70	68
nC22	<5	10	140	<53	<16	36	93	50	50
nC23	<5	17	130	<56	<17	44	70	48	43
nC24	<5	8	100	<60	<18	29	<28	35	34
nC25	<6	16	110	<62	<19	42	<29	41	36
nC26	<6	5	110	<65	<20	19	<30	36	38
nC27	<6	17	160	<68	<21	50	<32	51	53
nC28	<6	3	150	<72	<22	14	<34	43	53
nC29	<6	15	170	<74	<23	35	<35	51	57
nC30	<6	2	110	<76	<23	<4	<36	37	41
nC31	<7	8	76	<78	<24	19	<36	35	30
nC32	<7	2	33	<80	<24	<4	<37	27	27
nC33	<7	2	<3	<82	<25	<4	<38	23	29
nC34	<7	<0.8	<3	<84	<26	<4	<39	23	30
nC35	<7	<0.8	<3	<89	<27	<5	<42	25	32
nC36	<8	<0.8	<3	<96	<29	<5	<45	27	35

Oil Based Muds non-polar hydrocarbon data

SERIES 5: FOLLOW-UP SAMPLING AFTER ONE OPEN WATER SEASON; NINUK I-53 (continued)

Sample I.D.	**5-08**	**5-09**	**5-10**	**5-11**	**5-11**	**5-12**	**5-13**	**5-14**	**5-26**	**MEAN**
Data I.D.	566/2	564/2	478/3	571/2	560/2	570/2	568/2	567/2	3204/2	
SAMPLE LOCATION										
Stratum	2	2	2	2	2	2	2	2	2	
Range	350	300	400	350	350	400	450	450	350	
Bearing	320	210	270	290	290	320	210	230	210	
Northing	7734272	7733709	7733971	7734081	7734081	7734293	7733663	7733672	7733758	
Easting	443371	443398	443181	443194	443194	443306	443271	443199	443437	
PHYSICAL CHARACTER										
%Clay/Silt	47.6	33.4	1.2	33.8	33.8	0.2	42.6	0.3	9.9	22.5
Depth (m)	15.0	14.0	14.0	14.0	14.0	14.0			10.0	13.6
BARIUM (ug/g)	1030	4040	1130	2470		1130	1160	1960	12500	3178
HYDROCARBONS										
TOTALS and RATIOS[(a)]										
Total non-polar hydrocarbon	4092	10357	376	13004	13822	423	4260	1042	54160	11282
Total n-alkanes	2992	3437	314	4094	3912	321	3049	504	18460	4120
Total isoprenoids	1039	6920	62	8910	9910	102	1157	528	35400	7114
Non-polar H/C, nC10 to phytane	3120	9420	113	12200	13160	259	3361	929	53420	10665
Total n-alkanes, nC10-12	531	0	1	310	390	76	464	181	3100	561
alkanes (nC10-18)/isoprenoids	2.00	0.36	0.82	0.37	0.33	1.54	1.90	0.76	0.51	0.96
trimethyltridecane/nC15	0.58	2.54	1.00	3.02	3.77	1.13	0.22	3.13	1.75	1.90
FTN/alkane	0.47	1.92	1.05	2.43	2.89	0.98	0.36	2.14	1.56	1.53
Total n-alkane/total nonpolar	0.73	0.33	0.84	0.31	0.28	0.76	0.72	0.48	0.34	0.53
Odd-even predominance	n/a	n/a	2.91	n/a	n/a	2.95	n/a	n/a	n/a	0.65
nC18/phytane	1.24	0.31	0.89	0.19	0.28	0.94	1.17	0.33	0.24	0.62

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 5: FOLLOW-UP SAMPLING AFTER ONE OPEN WATER SEASON; MINUK I-53 (continued)

Sample I.D.	5-08	5-09	5-10	5-11	5-11	5-12	5-13	5-14	5-26	MEAN
Data I.D.	566/2	564/2	478/3	571/2	560/2	570/2	568/2	567/2	3204/2	
H/C CONCENTRATIONS (ng/g dry weight basis)										
nC10	61	<9	<0.9	<6	<20	<0.7	54	10	300	51
nC11	300	<9	0.8	<6	<19	71	260	140	<9	91
nC12	170	<9	<0.8	310	390	5	150	31	2800	430
Norfarnesane(a)	<3	280	<0.8	250	270	<0.7	29	15	2600	383
(b)	<3	240	<0.8	460	540	<0.7	26	29	1900	356
(c)	70	540	<0.8	320	420	6	91	18	3900	596
(d)	70	630	<0.8	580	680	4	68	36	3500	619
(e)	110	1800	<0.8	1900	1500	8	130	82	5400	1215
nC13	260	960	<0.8	1100	880	6	290	76	5100	964
Farnesane	59	530	0.8	1000	970	6	83	55	5700	934
nC14	230	380	<0.8	460	410	9	280	30	4000	644
Trimethyl-nC13	180	990	4	1300	2000	17	70	100	4200	985
nC15	310	390	4	430	530	15	320	32	2400	492
nC16	240	350	11	460	470	16	280	38	1800	407
Norpristane	130	630	11	980	1100	16	160	59	2900	665
nC17	300	290	18	390	340	20	360	29	1100	316
Pristane	250	860	27	1400	1600	29	320	88	3100	853
nC18	210	130	17	140	230	15	210	15	520	165
Phytane	170	420	19	720	830	16	180	46	2200	511
nC19	200	130	18	200	170	16	190	15	120	118
nC20	210	360	30	170	130	27	190	36	410	174
nC21	150	110	23	120	110	21	140	13	87	86
nC22	110	76	20	84	75	17	110	10	63	63
nC23	120	81	27	88	56	20	100	9	60	62
nC24	56	47	20	44	34	14	51	6	<18	32
nC25	60	23	25	49	38	14	50	7	<18	32
nC26	26	51	15	17	24	6	17	3	<19	20
nC27	40	13	29	32	25	13	40	7	<20	24
nC28	<4	34	10	<7	<26	3	11	2	<21	13
nC29	<4	12	26	<7	<26	7	<6	5	<22	13
nC30	<4	<12	7	<7	<27	2	<6	<2	<22	10
nC31	<4	<12	13	<7	<27	4	<7	<2	<23	11
nC32	<4	<13	<2	<8	<28	<1	<7	<2	<23	10
nC33	<4	<13	<2	<8	<28	<1	0	<3	<24	9
nC34	<4	<13	<2	<8	<29	<1	<7	<3	<25	10
nC35	<4	<14	<2	<8	<31	<1	<7	<3	<26	11
nC36	<5	<15	<2	<9	<32	<1	<8	<3	<28	11

Oil Based Muds non-polar hydrocarbon data

SERIES 5: FOLLOW-UP SAMPLING AFTER ONE OPEN WATER SEASON; MINUK I-53 (continued)

Sample I.D.	**5-15**	**5-16**	**5-17**	**5-19**	**5-20**		**MEAN**	**S.D.**
Data I.D.	**477/3**	**472/3**	**473/3**	**474/3**	**454/4**			
SAMPLE LOCATION								
Stratum	3	3	3	3	3			
Range	900	950	700	500	950			
Bearing	230	240	310	270	260			
Northing	7733475	7733552	7734485	7734265	7733857			
Easting	442888	442771	442999	442862	443637			
PHYSICAL CHARACTER								
%Clay/Silt	96.0	91.0	97.0	91.5	95.0		94.4	2.5
Depth (m)								
BARIUM (ug/g)	1100		1100	1020	1040		1080	49
HYDROCARBONS								
TOTALS and RATIOS[(a)]								
Total non-polar hydrocarbon	8847	7238	7180	9070	11902	8847	1920	2559
Total n-alkanes	6522	5244	4889	6580	7367	6120	1026	1565
Total isoprenoids	2268	1974	2241	2390	4395	2654	985	1067
Non-polar H/C, nC10 to phytane	6145	5254	5981	7150	10355	6977	2006	2001
Total n-alkanes, nC10-12	507	350	540	780	1510	737	458	412
alkanes (nC10-18)/isoprenoids	1.71	1.66	1.67	1.99	1.36	1.68	0.23	0.5
trimethyltridecane/nC15	0.71	0.65	0.67	0.61	0.99	0.73	0.15	NA
FTN/alkane	0.50	0.53	0.51	0.46	0.74	0.55	0.11	NA
Total n-alkane/total nonpolar	0.74	0.72	0.68	0.73	0.62	0.70	0.05	0.11
Odd-even predominance	1.80	n/a	n/a	n/a	n/a	0.36	0.80	NA
nC18/phytane	1.19	1.23	1.18	1.22	0.93	1.15	0.13	NA

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 5: FOLLOW-UP SAMPLING AFTER ONE OPEN WATER SEASON; MINUK I-53 (continued)

Sample I.D.	5-15	5-16	5-17	5-19	5-20	MEAN	S.D.
Data I.D.	477/3	472/3	473/3	474/3	454/4		
H/C CONCENTRATIONS (ng/g dry weight basis)							
nC10	57	20	50	100	140	66	46
nC11	220	180	210	330	590	312	151
nC12	230	150	280	350	780	375	225
norfarnesane(a)	<4	30	49	52	45	34	18
(b)	<4	27	69	<9	100	39	38
(c)	130	66	59	120	490	201	175
(d)	72	45	74	78	250	128	95
(e)	140	66	100	100	660	268	261
nC13	370	270	430	490	1100	910	971
Farnesane	96	110	150	160	580	183	203
nC14	450	350	490	630	960	480	317
Trimethyl-nC13	400	320	410	460	880	412	283
nC15	560	490	610	750	890	550	305
nC16	590	540	570	690	540	488	246
Norpristane	310	300	290	330	320	258	127
nC17	840	750	650	870	590	617	321
Pristane	650	580	660	640	670	533	263
nC18	560	530	450	550	370	410	213
Phytane	470	430	380	450	400	355	177
nC19	460	440	370	480	350	350	179
nC20	470	540	300	400	300	335	189
nC21	400	330	220	350	270	262	143
nC22	290	220	120	230	200	177	103
nC23	290	210	94	190	170	159	100
nC24	160	96	34	95	84	78	55
nC25	160	97	31	75	95	76	56
nC26	87	36	10	38	<46	36	31
nC27	120	15	20	50	78	47	45
nC28	36	<6	<11	12	<51	19	20
nC29	69	<6	<11	<11	<53	25	29
nC30	46	<6	<11	<11	<54	21	23
nC31	56	<6	<12	<11	<56	24	26
nC32	58	<6	<12	<11	<57	24	26
nC33	<10	<6	<12	<12	<58	16	21
nC34	<10	<6	<12	<12	<60	17	22
nC35	<10	<7	<13	<12	<64	18	23
nC36	<11	<7	<14	<13	<68	19	25

Oil Based Muds non-polar hydrocarbon data

SERIES 5: FOLLOW-UP SAMPLING AFTER ONE OPEN WATER SEASON; MINUK I-53 (continued)

Sample I.D.	5-21	5-22	5-23	5-24	5-25	5-28	5-29	MEAN	S.D.
Data I.D.	3211/1	561/2	562/2	563/2	475/3	569/2	574/2		
SAMPLE LOCATION									
Stratum	4	4	4	4	4	4	4		
Range	950	400	600	800	750	500	700		
Bearing	0	0	20	190	20	340	10		
Northing	7734990	7734907	7734581	7733201	7734771	7734529	7734703		
Easting	443527	443552	443740	443267	443805	443349	443659		
PHYSICAL CHARACTER									
%Clay/Silt	94.0	3.9	93.0	94.0	90.0	94.0	91.0	80.0	33.6
Depth (m)									
BARIUM (ug/g)	1120	1880	1090	1890	1310	1410	1350	1436	328
HYDROCARBONS									
TOTALS and RATIOS[(a)]									
Total non-polar hydrocarbon	2336500	615	13640	26940	10259	17584	10771	345187	878123
Total n-alkanes	2269700	483	11172	20620	7338	14334	7042	332956	854047
Total isoprenoids	66800	132	2445	6110	2721	3090	3654	12136	24169
Non-polar H/C, nC10 to phytane	165500	246	6015	13840	8351	8550	8659	30166	59814
Total n-alkanes, nC10-12	6600	2	310	1390	1290	980	655	1604	2260
alkanes (nC10-18)/isoprenoids	1.48	0.86	1.46	1.27	2.07	1.77	1.37	1.47	0.38
trimethyltridecane/nC15	0.44	1.00	0.51	1.00	0.71	0.67	1.10	0.78	0.26
FTN/alkane	0.43	1.14	0.49	0.72	0.47	0.50	0.60	0.62	0.25
Total n-alkane/total nonpolar	0.97	0.79	0.82	0.77	0.72	0.82	0.65	0.79	0.10
Odd-even predominance	1.20	3.32	1.09	1.33	1.28	1.17	n/a	1.34	0.99
nC18/phytane	0.66	0.90	0.95	0.98	1.31	1.10	1.26	1.02	0.22

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 5: FOLLOW-UP SAMPLING AFTER ONE OPEN WATER SEASON; MINUK I-53 (continued)

Sample I.D.	5-21	5-22	5-23	5-24	5-25	5-28	5-29	MEAN	S.D.
Data I.D.	3211/1	561/2	562/2	563/2	475/3	569/2	574/2		
H/C CONCENTRATIONS (ng/g dry weight basis)									
nC10	<360	<0.8	23	210	200	160	75	147	125
nC11	3500	0.8	97	510	460	410	260	748	1228
nC12	3100	0.8	190	670	630	410	320	760	1058
Norfarnesane(a)	<360	<0.8	45	210	110	<10	110	121	128
(b)	<360	<0.8	100	180	91	<10	84	118	122
(c)	<360	<0.8	90	580	220	180	270	243	189
(d)	<360	<0.8	120	440	130	150	200	200	151
(e)	<360	<0.8	230	900	270	250	360	339	275
nC13	5200	2	500	1500	840	700	600	1335	1762
Farnesane	2000	7	180	570	250	170	370	507	682
nC14	7900	6	440	980	750	680	1100	1694	2760
Trimethyl-nC13	4800	19	360	1100	560	570	740	1164	1637
nC15	11000	19	700	1100	790	850	670	2161	3911
nC16	18000	19	530	970	780	730	630	3094	6580
Norpristane	9000	24	280	530	290	390	330	1549	3289
nC17	31000	40	730	1200	760	960	760	5064	11442
Pristane	22000	53	660	1000	480	870	720	3683	8083
nC18	19000	26	360	590	420	560	590	3078	7024
Phytane	29000	29	380	600	320	510	470	4473	10817
nC19	59000	30	490	570	250	480	510	8761	22154
nC20	18000	91	290	490	200	430	410	2844	6684
nC21	190000	34	390	440	140	560	330	27413	71694
nC22	71000	29	800	350	93	1100	200	10510	26676
nC23	140000	37	1300	530	160	1700	210	20562	52671
nC24	190000	26	1300	500	24	1600	130	27654	71591
nC25	210000	36	1000	460	28	1200	110	30405	79195
nC26	210000	18	720	410	52	720	42	30280	79250
nC27	190000	34	470	460	90	450	92	27371	71713
nC28	170000	7	290	580	110	270	24	24469	64174
nC29	200000	18	220	1200	190	220	39	28841	75475
nC30	150000	4	150	1200	160	130	15	21666	56592
nC31	150000	4	120	1800	150	96	<16	21741	56561
nC32	85000	1	44	1100	130	78	<16	12338	32043
nC33	59000	<1	28	1000	68	<16	<17	8590	22232
nC34	41000	<1	13	890	41	<16	<17	5997	15438
nC35	25000	<1	0	640	22	<17	<18	3671	9408
nC36	13000	<1	0	480	<13	<18	<19	1933	4883

Oil Based Muds non-polar hydrocarbon data

SERIES 5: FOLLOW-UP SAMPLING AFTER ONE OPEN WATER SEASON; MINUK I-53 (continued)

Sample I.D.	5-31	5-32	5-33	5-34	5-35	5-35	MEAN	S.D.
Data I.D.	575/2	573/2	3206/1	576/2	458/3	577/2		
SAMPLE LOCATION								
Stratum	5	5	5	5	5	5		
Range	450	950	600	350	650	650		
Bearing	60	120	110	110	80	80		
Northing	7734261	7733601	7733807	7733903	7734137	7734137		
Easting	443934	444358	444141	443887	444187	444187		
PHYSICAL CHARACTER								
%Clay/Silt	52.7	88.0	28.9	11.4	76.2	76.2	55.6	30.2
Depth (m)								
BARIUM (ug/g)	1110	1730	17100	99100	6940		25196	41807
HYDROCARBONS								
TOTALS and RATIOS[(a)]								
Total non-polar hydrocarbon	2881	20947	136063	213947	56670	76370	84480	78685
Total n-alkanes	1971	10797	41663	6047	18470	25730	17446	14627
Total isoprenoids	868	10030	92900	207900	38200	50640	66756	76471
Non-polar H/C, nC10 to phytane	2410	17960	134600	213200	54600	75800	83095	78991
Total n-alkanes, nC10-12	332	1320	15500	0	0	4700	3642	6076
alkanes (nC10-18)/isoprenoids	1.78	0.79	0.45	0.03	0.43	0.50	0.66	0.60
trimethyltridecane/nC15	0.62	1.20	1.78	n/a	1.71	2.06	1.23	0.79
FTN/alkane	0.46	1.01	1.84	n/a	1.62	1.57	1.08	0.73
Total n-alkane/total nonpolar	0.68	0.52	0.31	0.03	0.33	0.34	0.37	0.22
Odd-even predominance	1.95	3.38	n/a	n/a	n/a	n/a	0.89	1.45
nC18/phytane	1.38	0.91	0.42	0.22	0.31	0.50	0.62	0.44

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 5: FOLLOW-UP SAMPLING AFTER ONE OPEN WATER SEASON; MINUK I-53 (continued)

Sample I.D.	5-31	5-32	5-33	5-34	5-35	5-35	MEAN	S.D.
Data I.D.	575/2	573/2	3206/1	576/2	458/3	577/2		
H/C CONCENTRATIONS (ng/g dry weight basis)								
nC10	42	120	1500	<23	<45	<42	295	591
nC11	150	380	<58	<23	<44	<42	116	137
nC12	140	820	14000	<23	<44	4700	3288	5548
Norfarnesane(a)	<6	470	12000	24000	1800	3100	6896	9463
(b)	<6	840	9400	20000	1500	6700	6408	7614
(c)	96	650	17000	29000	3500	3800	9008	11578
(d)	72	860	13000	16000	4100	6200	6705	6500
(e)	110	1600	17000	23000	7200	11000	9985	8891
nC13	150	1500	14000	<22	5800	9200	5112	5653
Farnesane	110	1300	9300	28000	5700	6400	8468	10152
nC14	300	1600	4400	<21	4000	4000	2387	1991
Trimethyl-nC13	160	1800	6400	41000	7000	6400	10460	15223
nC15	260	1500	3600	<21	4100	3100	2097	1750
nC16	200	630	2400	<21	1200	2800	1209	1159
Norpristane	83	650	3400	11000	2400	2700	3372	3945
nC17	180	780	1000	4000	780	940	1280	1364
Pristane	150	1200	3500	10000	3300	3500	3608	3427
nC18	120	600	800	1300	520	420	627	399
Phytane	87	660	1900	5900	1700	840	1848	2096
nC19	68	500	<23	320	420	170	250	194
nC20	70	470	160	270	440	200	268	159
nC21	47	390	110	70	340	82	173	151
nC22	39	310	210	49	280	58	158	124
nC23	48	350	300	38	270	60	178	144
nC24	41	210	280	<32	150	<59	129	102
nC25	34	210	200	<34	170	<62	118	84
nC26	19	87	120	<36	<62	<66	65	36
nC27	45	220	83	<38	<64	<70	87	67
nC28	13	44	<34	<40	<66	<74	45	22
nC29	23	120	<35	<42	<66	<76	60	35
nC30	12	29	<35	<43	<67	<78	44	25
nC31	12	47	<36	<44	<67	<80	48	24
nC32	<12	<25	<37	<45	<67	<81	45	26
nC33	<12	<25	<38	<46	<69	<84	46	27
nC34	<13	<26	<40	<48	<70	<87	47	27
nC35	<14	<28	<42	<50	<73	<91	50	28
nC36	<14	<29	<45	<53	<76	<96	52	30

SERIES 5: FOLLOW-UP SAMPLING AFTER ONE OPEN WATER SEASON; MINUK I-53 (continued)

Sample I.D.	5-36	5-37	MEAN	S.D.
Data I.D.	578/2	451/2		
SAMPLE LOCATION				
Stratum	6	6		
Range	200	200		
Bearing	0	120		
Northing	7734214	7733696		
Easting	445492	445661		
PHYSICAL CHARACTER				
%Clay/Silt	97.0		97	NA
Depth (m)				
BARIUM (ug/g)	1480			
HYDROCARBONS				
TOTALS and RATIOS[a]				
Total non-polar hydrocarbon	5871	19337	12604	9522
Total n-alkanes	3883	12047	7965	5773
Total isoprenoids	1900	7100	4500	3677
Non-polar H/C, nC10 to phytane	5138	17790	11464	8946
Total n-alkanes, nC10-12	588	2340	1464	1239
alkanes (nC10-18)/isoprenoids	1.70	1.51	1.60	0.14
trimethyltridecane/nC15	0.67	0.99	0.83	0.22
FTN/alkane	0.51	0.74	0.63	0.17
Total n-alkane/total nonpolar	0.66	0.62	0.64	0.03
Odd-even predominance	n/a	n/a	0.00	0.00
nC18/phytane	1.06	0.93	0.99	0.10

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 5: FOLLOW-UP SAMPLING AFTER ONE OPEN WATER SEASON; MINUK I-53 (continued)

Sample I.D.	5-36	5-37	MEAN	S.D.
Data I.D.	578/2	451/2		
H/C CONCENTRATIONS (ng/g dry weight basis)				
nC10	88	190	139	72
nC11	230	850	540	438
nC12	270	1300	785	728
Norfarnesane(a)	<8	400	204	277
(b)	<8	510	259	355
(c)	200	690	445	346
(d)	160	950	555	559
(e)	270	1700	985	1011
nC13	610	5000	2805	3104
Farnesane	270	580	135	191
nC14	680	960	340	481
Trimethyl-nC13	310	880	155	219
nC15	460	890	230	325
nC16	380	540	190	269
Norpristane	190	320	95	134
nC17	350	590	175	247
Pristane	340	670	170	240
nC18	170	370	85	120
Phytane	160	400	80	113
nC19	140	350	70	99
nC20	120	300	60	85
nC21	78	270	39	55
nC22	70	200	35	49
nC23	81	170	41	57
nC24	60	84	30	42
nC25	54	95	27	38
nC26	29	<46	15	21
nC27	52	78	26	37
nC28	18	<51	9	13
nC29	31	<53	16	22
nC30	<16	<54	8	11
nC31	<16	<56	8	11
nC32	<16	<57	8	11
nC33	<17	<58	9	12
nC34	<18	<60	9	13
nC35	<18	<64	9	13
nC36	<19	<68	10	13

APPENDIX B

SUMMARY OF KAUBVIK I-43 HYDROCARBON, GRAIN SIZE AND BARIUM DATA FOR ALL STATIONS AND SAMPLING TRIPS

Notes for summary hydrocarbon data appendices.

Data is listed in this appendix for non-polar hydrocarbon data, barium and particle size for each sample and is summarised by the stratum in which each sample station was located (see the section Methods, Sampling Design and Rational). Polycyclic aromatic hydrocarbon data is not included in this appendix and is listed in Appendix D. The mean and sample standard deviation of these parameters and various selected of hydrocarbon ratios and totals are calculated for each stratum.

Data I.D. is the identification of the sample data in the hydrocarbon lab data system.

Location: Sample locations are given as a nominal range and bearing from the island or caisson centre, except for samples from stratum 6, the reference stratum, which are referenced to the centre of the control site, circular areas 500m in diameter, 2.75km due east of the island/caisson.

The absolute location of each station, calculated as the mean of the three successful sampling sediment grabs, is also given in Universal Transverse Mercator (UTM) co-ordinates, referenced to the 135°W meridian.

Particle size: Particle size distribution is summarised as percent clay and silt, the total less than 63um, 230 standard sieve mesh size.

Depth: The mean station depth is given in meters as recorded on the sampling vessel sounder at the moment of sampling.

All concentrations are given on a dry weight basis and when a concentration is below the instumental detection limit, the detection limit in ng/g is given following the < symbol. Values at or below the detection limit are not included in the calculation of totals or ratios.

Several totals and ratios presented and are defined below.

Totals

Total non-polar hydrocarbon is the sum of resolved hydrocarbons including normal alkanes from n-C10 to n-C36 plus the total 'isoprenoid' hydrocarbons from norfarnesane to phytane plus four other non alkanes with similar retention times to norfarnesane. It should be noted that no measurements were made of the unresolved complex mixture (UCM) or 'envelope' hydrocarbons.

Total n-alkanes is the sum of normal hydrocarbons from n-C10 to n-C36.

Total isoprenoid hydrocarbon is the sum of resolved hydrocarbons from norfarnesane to phytane plus four other non alkanes with similar retention times to norfarnesane.

Non-polar H/C, nC10 to phytane is the total normal alkane fron n-C10 to n-C18 plus the isoprenoids as defined above.

Ratios

Alkanes (nC10-18)/isoprenoids is the total of n-C10 to n-C18 alkanes divided by the total isoprenoids.

Trimethyltridecane/nC15 is the ratio of the closely eluting compounds 2,6,10-trimethyl tridecane divided by n-C15.

FTN/alkane is the total of the three isoprenoids farnesane, trimethyltridecane and norpristane divided by the total n-C14,n-C15 and n-C16.

Odd-even predominance is defined as:

$$[n\text{-}C27 + [6 \times n\text{-}C29] + n\text{-}C31] / 4 \times [n\text{-}C28 + n\text{-}c30]$$

Oil Based Muds non-polar hydrocarbon data

SERIES 2: BACKGROUND SAMPLING: KAUBVIK I-43

Sample I.D.	2-01	2-02	2-03	2-04	2-05	2-29	2-33	MEAN	S.D.
Data I.D.	369/2	361/2	368/2	352/2	354/2	362/2	376/2		
SAMPLE LOCATION									
Stratum	1	1	1	1	1	1	1		
Range	200	250	150	250	200	250	400		
Bearing	230	230	220	240	220	180	130		
Northing	7751821	7751765	7751833	7751784	7751784	7751647	7751669		
Easting	483617	483626	483686	483590	483649	483817	484101		
PHYSICAL CHARACTER									
%Clay/Silt	11.8	24.5	0.9	7.2	0.0	28.5	61.0	50.7	88.5
Depth (m)	16.8	17.7	15.1	18.1	17.6	18.2	18.1	17.4	1.1
BARIUM (ug/g)	1110	1060	1390	1640	1460	1300	1300	1323	200
HYDROCARBONS									
TOTALS and RATIOS[(a)]									
Total non-polar hydrocarbon	1399	2556	250	868	254	4555	12938	3260	4530
Total n-alkanes	1194	2100	217	743	228	3951	11234	2810	3938
Total isoprenoids	204	434	31	121	23	594	1684	442	587
Non-polar H/C, nC10 to phytane	537	1217	90	326	63	1498	4428	1166	1540
Total n-alkanes, nC10-12	5	106	9	13	5	52	134	46	54
alkanes (nC10-18)/isoprenoids	1.63	1.80	1.90	1.69	1.74	1.52	1.63	1.70	0.13
trimethyltridecane/nC15	0.52	0.58	0.50	0.53	0.40	0.63	0.61	0.54	0.08
FTN/alkane	0.48	0.47	0.48	0.48	0.50	0.47	0.60	0.50	0.04
Total n-alkane/total nonpolar	0.85	0.82	0.87	0.86	0.90	0.87	0.87	0.86	0.02
Odd-even predominance	2.82	2.77	6.75	2.76	3.82	1.67	1.66	3.18	1.74
nC18/phytane	1.45	1.30	1.10	1.24	1.25	1.22	1.54	1.30	0.15

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 2: BACKGROUND SAMPLING: KAUBVIK I-43 (continued)

Sample I.D.	2-01	2-02	2-03	2-04	2-05	2-29	2-33	MEAN	S.D.
Data I.D.	369/2	361/2	368/2	352/2	354/2	362/2	376/2		
H/C CONCENTRATIONS (ng/g dry weight basis)									
nC10	1	22	2	4	3	10	20	9	9
nC11	1	37	3	3	1	16	34	14	16
nC12	3	47	4	6	1	26	80	24	30
Norfarnesane(a)	<1	<3	<2	<2	<1	<1	<4	2	1
(b)	<1	<3	<2	<2	<1	<1	<4	2	1
(c)	<1	11	<2	<2	<1	8	<4	4	4
(d)	<1	13	<2	<2	<1	8	25	7	9
(e)	2	24	<2	<2	<1	15	49	14	18
nC13	10	71	4	12	2	46	160	44	57
Farnesane	6	24	2	6	1	28	90	22	32
nC14	23	86	5	21	2	76	250	66	88
Trimethyl-nC13	24	70	4	17	2	76	250	63	88
nC15	46	120	8	32	5	120	410	106	142
nC16	65	120	10	34	7	150	480	124	166
Norpristane	34	60	5	19	4	59	340	74	119
nC17	100	160	12	51	9	240	740	187	257
Pristane	80	140	10	45	8	220	560	152	195
nC18	84	120	11	42	10	220	570	151	199
Phytane	58	92	10	34	8	180	370	107	130
nC19	88	160	12	50	16	240	720	184	250
nC20	97	130	30	54	65	210	500	155	163
nC21	80	130	11	44	10	230	750	179	263
nC22	61	98	9	37	8	230	500	135	178
nC23	76	120	15	54	13	250	560	155	196
nC24	53	75	8	35	8	200	400	111	143
nC25	76	100	16	48	12	310	740	186	265
nC26	37	64	6	30	6	180	350	96	127
nC27	88	140	18	58	14	260	600	168	208
nC28	34	51	2	21	5	160	380	93	137
nC29	74	110	14	46	14	240	690	170	242
nC30	17	28	2	12	2	120	440	89	160
nC31	43	74	6	30	9	170	700	147	250
nC32	10	15	3	6	1	110	380	75	140
nC33	18	28	2	8	3	91	330	69	119
nC34	5	6	2	3	1	27	210	36	77
nC35	3	5	2	3	2	18	180	30	66
nC36	2	5	2	3	2	11	80	15	29

Oil Based Muds non-polar hydrocarbon data

SERIES 2: BACKGROUND SAMPLING: KAUBVIK I-43 (continued)

Sample I.D.	2-10	2-26	MEAN	S.D.
Data I.D.	366/2	386/2		
SAMPLE LOCATION				
Stratum	2	2		
Range	400	450		
Bearing	220	190		
Northing	7751661	7751505		
Easting	483561	483718		
PHYSICAL CHARACTER				
%Clay/Silt	39.0	87.7	63.4	34.4
Depth (m)	17.9	17.9	17.9	0.0
BARIUM (ug/g)	1070	975	1023	67
HYDROCARBONS				
TOTALS and RATIOS[(a)]				
Total non-polar hydrocarbon	7864	24640	16252	11862
Total n-alkanes	7002	22670	14836	11079
Total isoprenoids	853	1890	1372	733
Non-polar H/C, nC10 to phytane	2065	5230	3648	2238
Total n-alkanes, nC10-12	32	390	211	253
alkanes (nC10-18)/isoprenoids	1.42	1.77	1.59	0.24
trimethyltridecane/nC15	0.55	0.67	0.61	0.09
FTN/alkane	0.61	0.61	0.61	0.00
Total n-alkane/total nonpolar	0.89	0.92	0.91	0.02
Odd-even predominance	1.78	1.20	1.49	0.41
nC18/phytane	1.27	1.58	1.42	0.22

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 2: BACKGROUND SAMPLING: KAUBVIK I-43 (continued)

Sample I.D.	2-10	2-26	MEAN	S.D.
Data I.D.	366/2	386/2		
H/C CONCENTRATIONS (ng/g dry weight basis)				
nC10	9	80	45	50
nC11	9	130	70	86
nC12	14	180	97	117
Norfarnesane(a)	<2	<4	3	1
(b)	<2	<4	3	1
(c)	<2	55	29	37
(d)	<2	65	34	45
(e)	<2	120	61	83
nC13	37	280	159	172
Farnesane	21	140	81	84
nC14	73	360	217	203
Trimethyl-nC13	82	330	206	175
nC15	150	490	320	240
nC16	190	490	340	212
Norpristane	150	350	250	141
nC17	400	730	565	233
Pristane	340	450	395	78
nC18	330	600	465	191
Phytane	260	380	320	85
nC19	400	820	610	297
nC20	340	690	515	247
nC21	350	640	495	205
nC22	320	820	570	354
nC23	380	770	575	276
nC24	300	670	485	262
nC25	470	970	720	354
nC26	280	1100	690	580
nC27	490	920	705	304
nC28	300	970	635	474
nC29	530	1600	1065	757
nC30	280	1600	940	933
nC31	470	1800	1135	940
nC32	270	2000	1135	1223
nC33	300	1600	950	919
nC34	170	910	540	523
nC35	100	980	540	622
nC36	49	550	300	354

Oil Based Muds non-polar hydrocarbon data

SERIES 2: BACKGROUND SAMPLING: KAUBVIK I-43 (continued)

Sample I.D.	2-16	2-28	MEAN	S.D.
Data I.D.	373/2	390/2		
SAMPLE LOCATION				
Stratum	3	3		
Range	650	500		
Bearing	210	200		
Northing	7751382	7751481		
Easting	483469	483588		
PHYSICAL CHARACTER				
%Clay/Silt	72.0	83.6	77.8	8.2
Depth (m)	18.8	18.0	18.4	0.6
BARIUM (ug/g)	976	1310	1143	236
HYDROCARBONS				
TOTALS and RATIOS[(a)]				
Total non-polar hydrocarbon	7394	11934	9664	3210
Total n-alkanes	6454	10643	8549	2962
Total isoprenoids	928	1254	1091	231
Non-polar H/C, nC10 to phytane	2264	3529	2897	894
Total n-alkanes, nC10-12	69	185	127	82
alkanes (nC10-18)/isoprenoids	1.44	1.81	1.63	0.26
trimethyltridecane/nC15	0.61	0.48	0.55	0.09
FTN/alkane	0.64	0.44	0.54	0.14
Total n-alkane/total nonpolar	0.87	0.89	0.88	0.01
Odd-even predominance	1.56	2.32	1.94	0.54
nC18/phytane	1.22	1.41	1.32	0.13

(a) see notes at beginning of this appendix for details.

SERIES 2: BACKGROUND SAMPLING: KAUBVIK I-43 (continued)

Sample I.D.	2-16	2-28	MEAN	S.D.
Data I.D.	373/2	390/2		

H/C CONCENTRATIONS (ng/g dry weight basis) .

nC10	12	37	25	18
nC11	23	57	40	24
nC12	34	91	63	40
Norfarnesane(a)	<2	<8	5	4
(b)	<2	<8	5	4
(c)	10	<8	9	1
(d)	11	<8	10	2
(e)	21	<8	15	9
nC13	67	140	104	52
Farnesane	36	54	45	13
nC14	110	220	165	78
Trimethyl-nC13	110	160	135	35
nC15	180	330	255	106
nC16	220	370	295	106
Norpristane	180	190	185	7
nC17	360	550	455	134
Pristane	290	510	400	156
nC18	330	480	405	106
Phytane	270	340	305	49
nC19	410	600	505	134
nC20	350	480	415	92
nC21	340	520	430	127
nC22	340	450	395	78
nC23	380	590	485	148
nC24	310	460	385	106
nC25	440	690	565	177
nC26	300	400	350	71
nC27	590	950	770	255
nC28	290	420	355	92
nC29	370	940	655	403
nC30	210	370	290	113
nC31	300	750	525	318
nC32	200	250	225	35
nC33	180	300	240	85
nC34	70	130	100	42
nC35	36	68	52	23
nC36	14	37	26	16

Oil Based Muds non-polar hydrocarbon data

SERIES 2: BACKGROUND SAMPLING: KAUBVIK I-43 (continued)

Sample I.D.	2-08	2-09	2-09	2-11	2-12	2-12	2-14	2-17	2-18	2-19
Data I.D.	365/2	359/2	444/2	367/2	445/2	371/2	372/2	374/2	378/2	380/2
SAMPLE LOCATION										
Stratum	4	4	4	4	4	4	4	4	4	4
Range	300	400	400	300	450	400	350	700	1200	650
Bearing	300	280	280	290	260	270	270	300	300	290
Northing	7752070	7751978	7751978	7752026	7751916	7751916	7751921	7752314	7752516	7752196
Easting	483566	483386	483386	483500	483399	483399	483497	483193	483317	483217
PHYSICAL CHARACTER										
%Clay/Silt	79.6	92.2	92.2	37.4	11.8	11.8	4.2	96.6	99.7	95.8
Depth (m)	18.0	18.1	18.1	18.4	18.5	18.5	18.4	18.6	19.2	18.3
BARIUM (ug/g)	1270	898		804	1200		1320	963	1010	982
HYDROCARBONS										
TOTALS and RATIOS(a)										
Total non-polar hydrocarbon	9311	13068	14606	3829	2037	2169	1011.1	16066	17272	15859
Total n-alkanes	7741	11095	12673	3432	1817	1912	962.2	13503	14243	13227
Total isoprenoids	1543	1959	1910	393	214	253	46.9	2528	2960	2540
Non-polar H/C, nC10 to phytane	3944	4883	5131	970	638	684	124.1	6660	7469	6522
Total n-alkanes, nC10-12	111	46	481	12	112	22	3.2	222	389	452
alkanes (nC10-18)/isoprenoids	1.56	1.49	1.69	1.47	1.98	1.70	1.65	1.63	1.52	1.57
trimethyltridecane/nC15	0.66	0.53	0.58	0.45	0.55	0.52	0.44	0.63	0.66	0.69
FTN/alkane	0.54	0.63	0.62	0.60	0.61	0.44	0.44	0.56	0.69	0.63
Total n-alkane/total nonpolar	0.83	0.85	0.87	0.90	0.89	0.88	0.95	0.84	0.82	0.83
Odd-even predominance	1.89	1.69	2.20	1.58	2.82	2.28	1.49	1.76	1.71	1.86
nC18/phytane	1.31	1.50	1.26	1.42	1.52	1.29	1.47	1.32	1.29	1.47

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 2: BACKGROUND SAMPLING: KAUBVIK I-43 (continued)

Sample I.D.	2-08	2-09	2-09	2-11	2-12	2-12	2-14	2-17	2-18	2-19
Data I.D.	365/2	359/2	444/2	367/2	445/2	371/2	372/2	374/2	378/2	380/2
H/C CONCENTRATIONS (ng/g dry weight basis)										
nC10	27	14	23	4	6	4	2	35	69	92
nC11	27	14	380	4	100	7	0.6	67	130	140
nC12	57	18	78	4	6	11	0.6	120	190	220
Norfarnesane(a)	<5	<3	0	<0.8	0	<2	<0.6	<3	<4	<3
(b)	<5	<3	0	<0.8	0	<2	<0.6	<3	<4	<3
(c)	<5	<3	0	<0.8	0	<2	<0.6	37	59	74
(d)	<5	<3	0	<0.8	0	<2	<0.6	48	71	86
(e)	32	<3	0	<0.8	0	6	<0.6	83	130	150
nC13	130	58	160	5	8	21	2	250	350	380
Farnesane	81	49	70	4	6	10	0.9	140	180	200
nC14	260	150	280	20	18	40	4	360	460	450
Trimethyl-nC13	230	190	250	27	21	33	4	350	430	410
nC15	350	360	430	60	38	63	9	560	650	590
nC16	390	590	500	120	55	82	16	850	670	580
Norpristane	230	450	430	88	41	38	8	500	610	410
nC17	610	910	690	190	99	110	21	1100	1100	810
Pristane	550	730	620	150	84	94	16	770	790	720
nC18	550	810	680	170	94	93	22	790	890	720
Phytane	420	540	540	120	62	72	15	600	690	490
nC19	650	820	660	230	110	130	34	1100	1000	790
nC20	520	680	700	210	150	100	50	610	680	550
nC21	530	660	960	230	170	110	38	660	800	670
nC22	410	620	660	190	110	92	31	630	800	600
nC23	430	640	790	200	120	120	40	690	770	730
nC24	270	510	510	160	80	76	24	490	590	560
nC25	370	810	770	220	110	130	45	810	1100	930
nC26	190	460	490	150	52	64	22	530	540	530
nC27	420	760	860	260	120	160	58	760	900	940
nC28	180	390	320	150	41	64	37	480	480	480
nC29	350	580	900	220	120	130	89	760	700	780
nC30	190	300	450	130	40	50	79	360	350	350
nC31	280	420	520	190	73	100	100	600	570	570
nC32	200	220	480	120	36	50	74	340	230	330
nC33	160	140	240	110	31	53	68	350	130	360
nC34	120	88	69	41	11	26	42	140	67	70
nC35	55	58	48	32	12	18	34	65	69	69
nC36	42	29	48	16	13	12	22	31	27	28

Oil Based Muds non-polar hydrocarbon data

SERIES 2: BACKGROUND SAMPLING: KAUBVIK I-43 (continued)

Sample I.D.	2-22	2-23	2-24	2-25	2-27	2-32	MEAN	S.D.
Data I.D.	382/2	383/2	385/2	387/2	389/2	356/2		
SAMPLE LOCATION								
Stratum	5	5	5	5	5	5		
Range	700	600	350	800	350	1050		
Bearing	330	330	10	800	330	110		
Northing	7752553	7752478	7752290	7752693	7752230	7752783		
Easting	483446	483537	483807	483826	483629	484302		
PHYSICAL CHARACTER								
%Clay/Silt	99.7	99.6	38.6	99.5	52.5	99.7	81.6	28.3
Depth (m)	18.6	19.1	18.2	18.5	18.1	18.3	18.5	0.4
BARIUM (ug/g)	954	954	985	937	963	1280	1012	132
HYDROCARBONS TOTALS and RATIOS[a]								
Total non-polar hydrocarbon	14922	19835	6825	13267	7598	17142	13265	5187
Total n-alkanes	12155	16653	6039	11268	6616	14501	11205	4224
Total isoprenoids	2730	3062	785	1999	949	2588	2019	958
Non-polar H/C, nC10 to phytane	6862	8352	1907	4961	2683	6573	5223	2523
Total n-alkanes, nC10-12	302	630	16	182	184	285	267	205
alkanes (nC10-18)/isoprenoids	1.51	1.73	1.43	1.48	1.83	1.54	1.59	0.16
trimethyltridecane/nC15	0.67	0.68	0.59	0.64	0.59	0.63	0.63	0.04
FTN/alkane	0.63	0.60	0.63	0.60	0.46	0.62	0.59	0.06
Total n-alkane/total nonpolar	0.81	0.84	0.88	0.85	0.87	0.85	0.85	0.02
Odd-even predominance	1.71	1.80	1.79	1.71	2.28	1.86	1.86	0.21
nC18/phytane	1.12	1.54	1.39	1.32	1.25	1.54	1.36	0.17

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 2: BACKGROUND SAMPLING: KAUBVIK I-43 (continued)

Sample I.D.	2-22	2-23	2-24	2-25	2-27	2-32	MEAN	S.D.
Data I.D.	382/2	383/2	385/2	387/2	389/2	356/2		
H/C CONCENTRATIONS (ng/g dry weight basis)								
nC10	37	120	1	<4	33	53	41	43
nC11	95	190	4	62	59	92	84	62
nC12	170	320	11	120	92	140	142	103
Norfarnesane(a)	<3	<3	<1	<4	<4	<3	3	1
(b)	<3	<3	<1	<4	<4	<3	3	1
(c)	53	92	<1	48	<4	46	41	34
(d)	67	120	<1	46	<4	55	49	44
(e)	120	190	<1	75	46	97	88	65
nC13	330	410	26	220	150	270	234	136
Farnesane	180	250	23	110	53	140	126	83
nC14	450	570	60	300	190	370	323	183
Trimethyl-nC13	430	520	82	280	160	360	305	165
nC15	640	760	140	440	270	570	470	234
nC16	670	960	190	470	280	620	532	281
Norpristane	500	610	140	330	130	460	362	197
nC17	1000	1100	370	690	360	990	752	329
Pristane	720	720	310	610	320	860	590	227
nC18	740	860	320	660	300	880	627	258
Phytane	660	560	230	500	240	570	460	182
nC19	970	1100	370	740	390	1000	762	318
nC20	780	900	320	510	300	710	587	249
nC21	970	840	310	690	330	780	653	274
nC22	650	800	310	540	290	770	560	222
nC23	650	850	350	590	420	830	615	206
nC24	440	670	280	410	260	640	450	174
nC25	700	1100	480	720	390	920	718	265
nC26	430	640	270	490	220	600	442	171
nC27	610	950	490	730	550	1100	738	241
nC28	380	590	280	460	240	540	415	140
nC29	560	900	420	730	510	830	658	191
nC30	250	400	190	380	200	360	297	94
nC31	330	770	350	650	400	630	522	185
nC32	140	370	190	210	130	240	213	87
nC33	91	430	190	170	150	350	230	131
nC34	62	72	43	76	67	130	75	29
nC35	30	74	57	180	46	80	78	53
nC36	17	27	18	30	22	59	29	16

Oil Based Muds non-polar hydrocarbon data

SERIES 2: BACKGROUND SAMPLING: KAUBVIK I-43 (continued)

Sample I.D.	2-37	2-38	2-39	MEAN	S.D.
Data I.D.	355/2	357/2	358/2		
SAMPLE LOCATION					
Stratum	6	6	6		
Range	200	50	100		
Bearing	270	90	350		
Northing	7751952	7751932	7751994		
Easting	486364	486556	486528		
PHYSICAL CHARACTER					
%Clay/Silt	99.7	99.8		99.8	0.1
Depth (m)	17.4	17.5	17.7	17.5	0.2
BARIUM (ug/g)	1210	1200	1100	1170	61
HYDROCARBONS					
TOTALS and RATIOS[(a)]					
Total non-polar hydrocarbon	10607	13012	8570	10730	2224
Total n-alkanes	7380	10810	6605	8265	2238
Total isoprenoids	3097	2188	1951	2412	605
Non-polar H/C, nC10 to phytane	7767	5434	4869	6023	1536
Total n-alkanes, nC10-12	610	116	108	278	288
alkanes (nC10-18)/isoprenoids	1.51	1.48	1.50	1.50	0.01
trimethyltridecane/nC15	0.69	0.52	0.52	0.58	0.10
FTN/alkane	0.62	0.63	0.52	0.59	0.06
Total n-alkane/total nonpolar	0.70	0.83	0.77	0.77	0.07
Odd-even predominance	1.33	1.72	1.51	1.52	0.20
nC18/phytane	1.08	1.35	1.23	1.22	0.13

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 2: BACKGROUND SAMPLING: KAUBVIK I-43 (continued)

Sample I.D.	2-37	2-38	2-39	MEAN	S.D.
Data I.D.	355/2	357/2	358/2		
H/C CONCENTRATIONS (ng/g dry weight basis)					
nC10	130	14	14	53	67
nC11	190	34	32	85	91
nC12	290	68	62	140	130
Norfarnesane(a)	<4	<2	<3	3	1
(b)	<4	<2	<3	3	1
(c)	97	28	24	50	41
(d)	110	32	27	56	47
(e)	190	58	50	99	79
nC13	490	170	140	267	194
Farnesane	240	110	80	143	85
nC14	580	250	220	350	200
Trimethyl-nC13	530	270	240	347	159
nC15	770	520	460	583	164
nC16	710	610	610	643	58
Norpristane	510	490	350	450	87
nC17	840	880	740	820	72
Pristane	800	680	660	713	76
nC18	670	700	640	670	30
Phytane	620	520	520	553	58
nC19	490	790	740	673	161
nC20	390	650	540	527	131
nC21	350	760	460	523	212
nC22	310	600	410	440	147
nC23	220	610	340	390	200
nC24	120	410	230	253	146
nC25	65	650	170	295	312
nC26	34	430	44	169	226
nC27	76	610	87	258	305
nC28	55	380	50	162	189
nC29	110	570	100	260	269
nC30	110	270	84	155	101
nC31	140	440	120	233	179
nC32	120	150	100	123	25
nC33	110	140	94	115	23
nC34	71	51	64	62	10
nC35	43	42	41	42	1
nC36	26	25	27	26	1

Oil Based Muds non-polar hydrocarbon data

SERIES 2: BACKGROUND SAMPLING: KAUBVIK I-43 (continued)

Sample I.D.	2-36	MEAN	S.D.
Data I.D.	377/2		
SAMPLE LOCATION			
Stratum	4		
Range	400		
Bearing	90		
Northing	7731954		
Easting	484186		
PHYSICAL CHARACTER			
%Clay/Silt	21.7	58.5	40.5
Depth (m)	18.2	18.4	0.3
BARIUM (ug/g)	1240	1076	184
HYDROCARBONS			
TOTALS and RATIOS(a)			
Total non-polar hydrocarbon	4319	9050	6489
Total n-alkanes	3798	7673	5387
Total isoprenoids	505	1350	1093
Non-polar H/C, nC10 to phytane	1424	3495	2791
Total n-alkanes, nC10-12	77	175	182
alkanes (nC10-18)/isoprenoids	1.82	1.64	0.15
trimethyltridecane/nC15	0.63	0.58	0.08
FTN/alkane	0.48	0.57	0.08
Total n-alkane/total nonpolar	0.88	0.87	0.04
Odd-even predominance	2.18	1.95	0.39
nC18/phytane	1.29	1.37	0.10

Oil Based Muds non-polar hydrocarbon data

SERIES 2: BACKGROUND SAMPLING: KAUBVIK I-43 (continued)

Sample I.D.	2-36	MEAN	S.D.
Data I.D.	377/2		
H/C CONCENTRATIONS (ng/g dry weight basis)			
nC10	16	27	29
nC11	26	81	111
nC12	35	67	78
Norfarnesane(a)	<2	2	2
(b)	<2	2	2
(c)	<2	17	27
(d)	<2	20	32
(e)	16	38	56
nC13	58	129	140
Farnesane	27	70	73
nC14	94	194	176
Trimethyl-nC13	82	184	162
nC15	130	295	243
nC16	150	364	291
Norpristane	70	261	222
nC17	230	534	416
Pristane	170	427	319
nC18	180	454	341
Phytane	140	335	253
nC19	220	522	387
nC20	190	404	261
nC21	220	459	315
nC22	180	393	279
nC23	210	431	299
nC24	150	311	222
nC25	240	503	383
nC26	130	287	219
nC27	300	503	343
nC28	130	250	183
nC29	270	445	304
nC30	120	220	146
nC31	260	335	208
nC32	75	196	143
nC33	94	158	113
nC34	50	66	39
nC35	38	45	20
nC36	18	26	12

Oil Based Muds non-polar hydrocarbon data

SERIES 6: POST-DRILLING SAMPLING AT KAUBVIK I-43

Sample I.D.	6-01	6-02	6-03	6-04	6-04	6-05	6-05	MEAN	S.D.
Data I.D.	3120/1	3123/1	3125/1	3126/1	3126/1	3178/1	3144/2		
SAMPLE LOCATION									
Stratum	1	1	1	1	1	1	1		
Range	260	280	220	300	300	300	300		
Bearing	230	184	130	138	138	210	210		
Northing	7751773	7751661	7751799	7751717	7751717	7751680	7751680		
Easting	483641	483820	484009	484041	484041	483690	483690		
PHYSICAL CHARACTER									
%Clay/Silt	95.8	64.4	3.2	53.0	53.0	36.1	36.1	48.8	28.5
Depth (m)									
BARIUM (ug/g)	1160	1160	820	1580		1150		1174	270
HYDROCARBONS									
TOTALS and RATIOS (a)									
Total non-polar hydrocarbon	23747	287343	1401	92238	92238	2925	1934	71689	103428
Total n-alkanes	14337	178343	794	54108	54108	1619	1144	43493	64070
Total isoprenoids	8880	99000	591	37670	37670	1258	790	26551	36022
Non-polar H/C, nC10 to phytane	22430	283100	1240	91290	91290	2468	1685	70500	102090
Total n-alkanes, nC10-12	7930	148000	426	37460	37460	408	300	33141	53363
alkanes (nC10-18)/isoprenoids	1.53	1.86	1.10	1.42	1.42	0.96	1.13	1.35	0.31
trimethyltridecane/nC15	1.09	1.49	1.42	1.52	1.52	1.13	0.81	1.28	0.28
FTN/alkane*	1.13	1.47	1.47	1.47	1.47	1.29	0.92	1.32	0.22
Total n-alkane/total nonpolar	0.60	0.62	0.57	0.59	0.59	0.55	0.59	0.59	0.02
Odd-even predominance	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.00	0.00
nC18/phytane	1.28	1.18	0.86	0.82	0.82	1.32	1.14	1.06	0.22

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 6: POST-DRILLING SAMPLING AT KAUBVIK I-43

Sample I.D.	6-01	6-02	6-03	6-04	6-04	6-05	6-05	MEAN	S.D.
Data I.D.	3120/1	3123/1	3125/1	3126/1	3126/1	3178/1	3144/2		
H/C CONCENTRATIONS (ng/g dry weight basis)									
nC10	530	10000	16	460	460	48	<3	1645	3691
nC11	4900	100000	280	26000	26000	210	180	22510	36123
nC12	2500	38000	130	11000	11000	150	120	8986	13706
Norfarnesane(a)	1000	14000	76	5300	5300	120	85	3697	5124
(b)	610	9900	44	3600	3600	66	49	2553	3622
(c)	1000	15000	76	5500	5500	120	85	3897	5480
(d)	550	8800	44	3400	3400	70	46	2330	3237
(e)	1300	17000	81	5800	5800	120	97	4314	6161
nC13	1600	12000	38	6600	6600	170	160	3881	4624
Farnesane	1600	18000	72	7600	7600	230	81	5026	6650
nC14	1200	11000	44	4200	4200	170	68	2983	3989
Trimethyl-nC13	1200	10000	74	4400	4400	170	89	2905	3677
nC15	1100	6700	52	2900	2900	150	110	1987	2426
nC16	660	2900	31	1600	1600	100	96	998	1081
Norpristane	540	2300	41	780	780	140	81	666	788
nC17	650	2200	34	550	550	130	96	601	749
Pristane	760	2900	55	910	910	160	120	831	988
nC18	410	1300	24	310	310	82	65	357	441
Phytane	320	1100	28	380	380	62	57	332	373
nC19	330	790	22	230	230	74	50	247	265
nC20	240	550	<3	120	120	44	0	154	194
nC21	160	390	13	98	98	49	33	120	129
nC22	100	250	14	65	65	35	21	79	81
nC23	100	250	14	190	190	40	25	116	95
nC24	60	160	11	36	36	26	18	50	51
nC25	110	210	15	66	66	37	24	75	67
nC26	33	89	11	<19	<19	17	10	28	28
nC27	80	230	16	73	73	45	31	78	71
nC28	40	120	19	<19	<19	<6	18	34	39
nC29	64	130	5	70	70	43	19	57	41
nC30	<18	<92	<4	<20	<20	<6	<6	24	31
nC31	17	54	<4	<20	<20	47	<6	24	19
nC32	32	420	21	<21	<21	<6	<6	75	152
nC33	47	600	<4	<20	<20	<6	<6	100	221
nC34	<20	<97	<4	<20	<20	<7	<6	25	33
nC35	<20	<100	<4	<21	<21	<7	<6	26	34
nC36	50	370	<5	<22	<22	<7	<7	69	134

Oil Based Muds non-polar hydrocarbon data

SERIES 6: POST-DRILLING SAMPLING AT KAUBVIK I-43 (continued)

Sample I.D.	6-09	6-10	6-11	6-12	6-13	6-15	MEAN	S.D.
Data I.D.	3213/1	3212/1	3145/1	3147/1	3148/1	3149/1		
SAMPLE LOCATION								
Stratum	2	2	2	2	2	2		
Range	350	410	460	390	500	390		
Bearing	180	130	138	160	199	241		
Northing	7751590	7751676	7751598	7751574	7751467	7751751		
Easting	483840	484154	484148	483973	483677	483499		
PHYSICAL CHARACTER								
%Clay/Silt	99.0	97.8	99.5	96.8	99.5	93.3	97.7	2.4
Depth (m)								
BARIUM (ug/g)	950	1020	940	960	950	1060	980	48
HYDROCARBONS								
TOTALS and RATIOS (a)								
Total non-polar hydrocarbon	8732	16866	8757	11150	8377	22756	12773	5845
Total n-alkanes	7035	11206	6517	7620	6563	14256	8866	3170
Total isoprenoids	1626	5220	2195	3230	1728	8250	3708	2596
Non-polar H/C, nC10 to phytane	4967	14880	5640	9380	4697	19710	9879	6178
Total n-alkanes, nC10-12	511	4340	455	2010	566	5250	2189	2121
alkanes (nC10-18)/isoprenoids	2.05	1.85	1.57	1.90	1.72	1.39	1.75	0.24
trimethyltridecane/nC15	0.41	0.71	0.46	0.54	0.49	0.88	0.58	0.18
FTN/alkane*	0.46	0.71	0.54	0.56	0.50	0.95	0.62	0.18
Total n-alkane/total nonpolar	0.81	0.66	0.74	0.68	0.78	0.63	0.72	0.07
Odd-even predominance	2.32	n/a	1.79	n/a	2.41	2.81	1.56	1.25
nC18/phytane	1.48	1.43	1.18	1.46	1.63	1.33	1.42	0.15

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 6: POST-DRILLING SAMPLING AT KAUBVIK I-43 (continued)

Sample I.D.	6-09	6-10	6-11	6-12	6-13	6-15	MEAN	S.D.
Data I.D.	3213/1	3212/1	3145/1	3147/1	3148/1	3149/1		
H/C CONCENTRATIONS (ng/g dry weight basis)								
nC10	71	440	45	300	86	250	199	157
nC11	280	2700	250	1100	290	3100	1287	1296
nC12	160	1200	160	610	190	1900	703	713
Norfarnesane(a)	<8	460	70	200	55	820	269	316
(b)	<8	250	39	110	<8	510	154	197
(c)	<8	440	73	200	63	810	266	308
(d)	<8	230	40	110	<8	480	146	184
(e)	56	620	83	300	100	1100	377	413
nC13	220	1100	250	660	33	1400	611	544
Farnesane	130	850	210	480	130	1500	550	541
nC14	370	1100	380	740	330	1300	703	417
Trimethyl-nC13	230	850	260	490	250	1400	580	466
nC15	560	1200	560	910	510	1600	890	439
nC16	590	790	720	790	500	750	690	119
Norpristane	340	500	420	390	290	550	415	97
nC17	630	700	610	660	590	720	652	51
Pristane	560	720	600	690	570	750	648	82
nC18	460	430	470	380	440	440	437	31
Phytane	310	300	400	260	270	330	312	50
nC19	410	370	670	320	450	420	440	121
nC20	330	270	550	250	390	420	368	111
nC21	320	250	240	170	320	290	265	58
nC22	290	170	140	99	300	240	207	83
nC23	320	200	170	150	300	270	235	71
nC24	220	110	110	88	230	190	158	63
nC25	330	150	220	130	300	260	232	80
nC26	190	66	180	52	220	120	138	69
nC27	410	140	340	120	370	310	282	122
nC28	200	<32	170	86	150	120	126	61
nC29	310	130	170	130	320	210	212	85
nC30	69	<34	35	<13	110	31	49	35
nC31	230	<34	110	<12	220	130	123	91
nC32	110	130	12	99	<12	35	66	53
nC33	<14	<34	<6	76	<14	<16	27	26
nC34	26	<34	<7	<16	<17	<19	20	9
nC35	<15	<35	<6	<16	<16	<18	18	9
nC36	<15	<37	<6	<15	<16	<17	18	10

Oil Based Muds non-polar hydrocarbon data

SERIES 6: POST-DRILLING SAMPLING AT KAUBVIK I-43 (continued)

Sample I.D.	6-17	6-18	6-21	6-22	MEAN	S.D.
Data I.D.	3151/1	3152/1	3153/1	3154/1		
SAMPLE LOCATION						
Stratum	3	3	3	3		
Range	680	670	1220	1650		
Bearing	190	159	180	190		
Northing	7751270	7751315	7750720	7750315		
Easting	483722	484080	483840	483553		
PHYSICAL CHARACTER						
%Clay/Silt	99.9	99.5	99.9	100.0	99.8	0.2
Depth (m)						
BARIUM (ug/g)	1060	910	940	940	962	66
HYDROCARBONS						
TOTALS and RATIOS (a)						
Total non-polar hydrocarbon	9557	7151	7146	6386	7560	1379
Total n-alkanes	7054	5383	5436	4503	5594	1063
Total isoprenoids	2333	1684	1633	1787	1859	322
Non-polar H/C, nC10 to phytane	6723	4388	4290	4963	5091	1128
Total n-alkanes, nC10-12	990	484	467	606	637	244
alkanes (nC10-18)/isoprenoids	1.88	1.61	1.63	1.78	1.72	0.13
trimethyltridecane/nC15	0.52	0.48	0.46	0.53	0.50	0.03
FTN/alkane*	0.47	0.63	0.56	0.52	0.55	0.07
Total n-alkane/total nonpolar	0.74	0.75	0.76	0.71	0.74	0.02
Odd-even predominance	2.87	2.24	5.10	2.56	3.19	1.30
nC18/phytane	1.59	1.62	1.34	1.43	1.50	0.13

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 6: POST-DRILLING SAMPLING AT KAUBVIK I-43 (continued)

Sample I.D.	6-17	6-18	6-21	6-22	MEAN	S.D.
Data I.D.	3151/1	3152/1	3153/1	3154/1		
H/C CONCENTRATIONS (ng/g dry weight basis)						
nC10	170	84	77	96	107	43
nC11	470	230	230	320	313	113
nC12	350	170	160	190	218	89
Norfarnesane(a)	120	64	52	70	77	30
(b)	70	35	27	38	43	19
(c)	120	63	54	74	78	29
(d)	73	38	30	42	46	19
(e)	160	84	70	93	102	40
nC13	440	230	220	290	295	101
Farnesane	200	200	160	200	190	20
nC14	480	320	300	430	383	87
Trimethyl-nC13	370	200	180	320	268	92
nC15	710	420	390	600	530	152
nC16	740	400	410	460	503	160
Norpristane	340	320	280	260	300	37
nC17	600	510	480	490	520	55
Pristane	610	470	490	480	513	66
nC18	430	340	390	300	365	57
Phytane	270	210	290	210	245	41
nC19	400	350	410	260	355	69
nC20	250	250	310	170	245	57
nC21	270	240	300	170	245	56
nC22	210	230	230	100	193	62
nC23	240	260	270	100	218	79
nC24	180	140	160	78	140	44
nC25	260	200	240	110	203	67
nC26	160	110	120	57	112	42
nC27	330	280	300	110	255	99
nC28	110	130	20	53	78	51
nC29	230	180	180	110	175	49
nC30	46	33	53	27	40	12
nC31	81	100	110	48	85	27
nC32	67	94	31	30	56	31
nC33	<24	150	98	<8	70	66
nC34	<24	16	24	<8	18	8
nC35	<25	<14	<10	28	19	9
nC36	<26	190	<10	27	63	85

SERIES 6: POST-DRILLING SAMPLING AT KAUBVIK I-43 (continued)

Sample I.D.	6-15	6-25	6-26	6-27	6-30	6-39	6-40	6-41	6-41	6-42
Data I.D.	3179/1	3155/1	3158/1	3159/1	3160/1	3165/1	3167/1	3174/1	3168/1	3170/1
SAMPLE LOCATION										
Stratum	4	4	4	4	4	4	4	4	4	4
Range	390	1610	460	480	259	260	260	390	390	810
Bearing	241	279	300	250	270	80	113	114	114	120
Northing	7751751	7752192	7752170	7751776	7751940	7751985	7751838	7751781	7751781	7751535
Easting	483499	482250	483442	483389	483581	484096	484079	484196	484196	484541
PHYSICAL CHARACTER										
%Clay/Silt	93.3	99.9	86.4	80.0	20.0	40.0	11.0	68.0	68.0	66.0
Depth (m)										
BARIUM (ug/g)		960	940	1020	1020	980	730	1640		950
HYDROCARBONS										
TOTALS and RATIOS (a)										
Total non-polar hydrocarbon	27584	10996	8222	10037	6082	2920	4584	48264	51786	5584
Total n-alkanes	17204	8487	5983	6087	3725	2174	2847	27394	30516	4043
Total isoprenoids	9920	2339	2049	3770	2270	746	1653	20240	20280	1472
Non-polar H/C, nC10 to phytane	23940	6169	5879	9220	5127	1619	4052	46540	50450	3721
Total n-alkanes, nC10-12	7660	1210	990	2720	1227	187	1594	21730	20690	429
alkanes (nC10-18)/isoprenoids	1.41	1.64	1.87	1.45	1.26	1.17	1.45	1.30	1.49	1.53
trimethyltridecane/nC15	1.00	0.64	0.47	0.96	0.91	0.83	1.38	1.54	1.35	0.54
FTN/alkane*	1.11	0.69	0.52	0.95	0.98	0.87	1.35	1.72	1.46	0.67
Total n-alkane/total nonpolar	0.62	0.77	0.73	0.61	0.61	0.74	0.62	0.57	0.59	0.72
Odd-even predominance	3.25	2.17	2.52	n/a	3.11	2.47	2.61	n/a	n/a	2.38
nC18/phytane	1.49	1.77	1.46	1.29	1.29	1.30	1.07	1.20	1.08	1.63

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 6: POST-DRILLING SAMPLING AT KAUBVIK I-43 (continued)

Sample I.D.	6-15	6-25	6-26	6-27	6-30	6-39	6-40	6-41	6-41	6-42
Data I.D.	3179/1	3155/1	3158/1	3159/1	3160/1	3165/1	3167/1	3174/1	3168/1	3170/1
H/C CONCENTRATIONS (ng/g dry weight basis)										
nC10	460	170	190	180	87	<2	84	630	990	69
nC11	5000	640	480	1800	770	100	1100	15000	14000	230
nC12	2200	400	320	740	370	87	410	6100	5700	130
Norfarnesane(a)	1100	160	86	420	230	41	200	3100	2900	47
(b)	650	95	60	250	140	27	120	1800	1700	27
(c)	1100	160	110	400	220	44	200	3200	2800	47
(d)	640	94	63	210	130	26	120	1900	1600	28
(e)	1300	180	130	490	280	84	240	3200	3400	63
nC13	1400	400	380	630	320	81	210	300	3900	180
Farnesane	1800	310	230	680	400	110	290	3800	3900	140
nC14	1300	390	440	610	330	95	200	1900	2500	230
Trimethyl-nC13	1400	280	270	520	320	83	220	2000	2300	190
nC15	1400	440	570	540	350	100	160	1300	1700	350
nC16	850	410	520	370	210	120	78	460	540	370
Norpristane	730	260	300	240	150	81	82	510	710	310
nC17	830	520	550	360	240	160	92	370	570	430
Pristane	810	540	540	390	260	150	120	530	720	460
nC18	580	460	380	220	180	130	65	240	270	260
Phytane	390	260	260	170	140	100	61	200	250	160
nC19	460	530	330	180	180	130	76	210	300	270
nC20	300	390	220	110	130	100	48	180	180	180
nC21	310	420	190	92	110	110	50	170	160	180
nC22	240	360	120	59	71	95	43	140	120	130
nC23	320	460	120	65	80	110	50	170	130	160
nC24	200	290	75	41	46	77	32	120	82	110
nC25	300	450	930	62	69	110	47	180	110	150
nC26	140	240	49	25	31	58	23	97	49	85
nC27	400	560	140	64	74	150	57	220	120	200
nC28	140	260	46	22	30	78	25	<76	<35	87
nC29	350	380	71	49	60	140	43	150	85	150
nC30	74	92	14	<11	8	31	8	<80	<38	41
nC31	280	210	38	32	39	87	30	87	<38	120
nC32	130	37	<8	<11	12	25	<6	<84	<38	<6
nC33	<19	110	<8	16	15	<5	<7	<87	<39	<6
nC34	<20	38	<8	<11	<4	<6	<7	<90	<40	<6
nC35	<20	<22	<8	<11	<4	<6	<7	<95	<43	<7
nC36	<21	<22	<8	<11	<4	<6	<8	<100	<46	<7

Oil Based Muds non-polar hydrocarbon data

SERIES 6: POST-DRILLING SAMPLING AT KAUBVIK I-43 (continued)

Sample I.D.	6-33	6-35	6-36	MEAN	S.D.
Data I.D.	3164/1	3166/1	3162/1		
SAMPLE LOCATION					
Stratum	5	5	5		
Range	280	410	1800		
Bearing	0	325	12		
Northing	7752220	7752276	7753701		
Easting	483840	483605	484214		
PHYSICAL CHARACTER					
%Clay/Silt	99.0	74.8	99.7	91.2	14.2
Depth (m)					
BARIUM (ug/g)	990	910	960	953	40
HYDROCARBONS					
TOTALS and RATIOS (a)					
Total non-polar hydrocarbon	11086	8845	5799	8577	2654
Total n-alkanes	9110	6338	4471	6640	2334
Total isoprenoids	1916	2357	1328	1867	516
Non-polar H/C, nC10 to phytane	5216	6427	3524	5056	1458
Total n-alkanes, nC10-12	460	1110	146	572	492
alkanes (nC10-18)/isoprenoids	1.72	1.73	1.65	1.70	0.04
trimethyltridecane/nC15	0.44	0.67	0.47	0.53	0.13
FTN/alkane*	0.51	0.60	0.52	0.54	0.05
Total n-alkane/total nonpolar	0.82	0.72	0.77	0.77	0.05
Odd-even predominance	2.41	2.90	2.82	2.71	0.26
nC18/phytane	1.58	1.72	1.46	1.59	0.13

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 6: POST-DRILLING SAMPLING AT KAUBVIK I-43 (continued)

Sample I.D.	6-33	6-35	6-36	MEAN	S.D.
Data I.D.	3164/1	3166/1	3162/1		
H/C CONCENTRATIONS (ng/g dry weight basis)					
nC10	60	150	<5	71.7	73.2
nC11	230	630	65	308.3	290.5
nC12	170	330	81	193.7	126.2
Norfarnesane(a)	53	130	<5	62.7	63.1
(b)	35	72	<5	37.3	33.6
(c)	62	130	<5	65.7	62.6
(d)	38	75	<5	39.3	35.0
(e)	88	180	43	103.7	69.8
nC13	230	370	120	240.0	125.3
Farnesane	150	310	85	181.7	115.8
nC14	390	440	210	346.7	121.0
Trimethyl-nC13	240	390	180	270.0	108.2
nC15	550	580	380	503.3	107.9
nC16	480	660	410	516.7	129.0
Norpristane	340	310	250	300.0	45.8
nC17	670	480	520	556.7	100.2
Pristane	580	510	490	526.7	47.3
nC18	520	430	410	453.3	58.6
Phytane	330	250	280	286.7	40.4
nC19	550	320	370	413.3	121.0
nC20	380	230	230	280.0	86.6
nC21	440	240	210	296.7	125.0
nC22	380	190	160	243.3	119.3
nC23	500	220	180	300.0	174.4
nC24	360	150	120	210.0	130.8
nC25	550	200	170	306.7	211.3
nC26	300	96	84	160.0	121.4
nC27	780	240	220	413.3	317.7
nC28	340	100	90	176.7	141.5
nC29	570	190	180	313.3	222.3
nC30	130	32	36	66.0	55.5
nC31	330	150	120	200.0	113.6
nC32	110	60	27	65.7	41.8
nC33	150	<15	64	76.3	68.3
nC34	<16	<15	14	15.0	1.0
nC35	<17	<16	<16	16.3	0.6
nC36	41	<17	<90	49.3	37.2

Oil Based Muds non-polar hydrocarbon data

SERIES 6: POST-DRILLING SAMPLING AT KAUBVIK I-43 (continued)

Sample I.D.	6-44	6-45	6-46	MEAN	S.D.
Data I.D.	3171/1	3172/1	3173/1		
SAMPLE LOCATION					
Stratum	6	6	6		
Range	2610	2590	2630		
Bearing	90	90	90		
Northing	7751940	7751940	7751940		
Easting	486450	486430	486470		
PHYSICAL CHARACTER					
%Clay/Silt	99.9	99.7	99.8	99.8	0.1
Depth (m)					
BARIUM (ug/g)	930	930	900		
HYDROCARBONS					
TOTALS and RATIOS (a)					
Total non-polar hydrocarbon	9340	6757	13198	9765	3241
Total n-alkanes	6701	5015	8658	6791	1823
Total isoprenoids	2419	1684	4300	2801	1349
Non-polar H/C, nC10 to phytane	7459	4201	10830	7497	3315
Total n-alkanes, nC10-12	1420	317	2260	1332	974
alkanes (nC10-18)/isoprenoids	2.08	1.49	1.52	1.70	0.33
trimethyltridecane/nC15	0.62	0.39	0.69	0.56	0.15
FTN/alkane*	0.50	0.47	0.71	0.56	0.13
Total n-alkane/total nonpolar	0.72	0.74	0.66	0.71	0.04
Odd-even predominance	5.04	2.08	2.71	3.28	1.56
nC18/phytane	1.45	1.21	1.00	1.22	0.23

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SERIES 6: POST-DRILLING SAMPLING AT KAUBVIK I-43 (continued)

Sample I.D.	6-44	6-45	6-46	MEAN	S.D.
Data I.D.	3171/1	3172/1	3173/1		
H/C CONCENTRATIONS (ng/g dry weight basis)					
nC10	220	58	240	173	100
nC11	750	170	1400	773	615
nC12	450	89	620	386	271
norfarnesane(a)	140	41	300	160	131
(b)	74	21	180	92	81
(c)	140	40	280	153	121
(d)	85	23	180	96	79
(e)	190	49	380	206	166
nC13	590	140	690	473	293
Farnesane	390	120	570	360	226
nC14	760	220	690	557	294
Trimethyl-nC13	530	160	570	420	226
nC15	860	410	830	700	252
nC16	560	620	870	683	164
Norpristane	160	310	550	340	197
nC17	530	340	670	513	166
Pristane	490	530	770	597	151
nC18	320	470	520	437	104
Phytane	220	390	520	377	150
nC19	360	350	330	347	15
nC20	200	290	220	237	47
nC21	210	330	250	263	61
nC22	130	220	180	177	45
nC23	140	240	210	197	51
nC24	96	120	130	115	17
nC25	160	170	190	173	15
nC26	71	97	110	93	20
nC27	180	220	220	207	23
nC28	29	100	94	74	39
nC29	140	160	200	167	31
nC30	27	56	50	44	15
nC31	110	120	140	123	15
nC32	28	44	44	39	9
nC33	<10	39	<9	19	17
nC34	<10	<4	<10	8	3
nC35	<11	100	40	50	45
nC36	<12	<5	<11	9	4

Oil Based Muds non-polar hydrocarbon data

SEDIMENT TRAP SAMPLES: KAUBVIK I-43, SERIES 6 (continued)

Sample I.D.	7-02	7-03
Data I.D.	3180/1	3182/1
SAMPLE LOCATION		
Stratum	4	4
Range	339	339
Bearing	123	123
Northing	7751755	7751755
Easting	484124	484124
PHYSICAL CHARACTER		
%Clay/Silt		
Depth (in core)		
HYDROCARBONS		
TOTALS and RATIOS (a)		
Total non-polar hydrocarbon	77095	23087
Total n-alkanes	41005	12957
Total isoprenoids	35380	9790
Non-polar H/C, nC10 to phytane	75210	21850
Total n-alkanes, nC10-12	25010	7640
alkanes (nC10-18)/isoprenoids	1.13	1.23
trimethyltridecane/nC15	1.71	2.31
FTN/alkane*	1.63	1.80
Total n-alkane/total nonpolar	0.53	0.56
Odd-even predominance	n/a	n/a
nC18/phytane	0.84	0.89

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

SEDIMENT TRAP SAMPLES: KAUBVIK I-43, SERIES 6 (continued)

Sample I.D.	7-02	7-03
Data I.D.	3180/1	3182/1
H/C CONCENTRATIONS (ng/g dry weight basis)		
nC10	710	340
nC11	15000	4800
nC12	9300	2500
Norfarnesane(a)	4300	540
(b)	2900	1200
(c)	4100	1300
(d)	2600	700
(e)	5400	240
nC13	4700	1100
Farnesane	7100	2000
nC14	3900	1100
Trimethyl-nC13	5800	2100
nC15	3400	910
nC16	1400	530
Norpristane	1300	480
nC17	1100	460
Pristane	1500	870
nC18	320	320
Phytane	380	360
nC19	350	240
nC20	190	190
nC21	210	170
nC22	150	120
nC23	170	140
nC24	99	79
nC25	140	110
nC26	63	41
nC27	170	100
nC28	63	<0.2
nC29	130	47
nC30	<25	<0.2
nC31	100	<0.2
nC32	50	<0.2
nC33	<26	<0.2
nC34	<27	<0.2
nC35	<27	<0.2
nC36	<28	<0.2

Oil Based Muds non-polar hydrocarbon data

CORE SAMPLES: KAUBVIK I-43, SERIES 6

Sample I.D.	7-04	7-07	7-46	7-45	7-52	7-55	7-36	7-41
Data I.D.	3183/1	3184/1	3186/1	3185/1	3187/1	3192/1	3193/1	3190/1
SAMPLE LOCATION								
Stratum	4	4	4	2	2	2	4	4
Range	380	380	380	380	380	380	380	380
Bearing	90	90	90	180	180	270	270	270
Northing	7751940	7751940	7751940	7751560	7751560	7751940	7751940	7751940
Easting	484220	484220	484220	483840	483840	483460	483460	483460
Core number	1	1	1	2	2	2	3	3
PHYSICAL CHARACTER								
%Clay/Silt								
Depth (in core)	0-1	3-6	12-14	0-2	4-7	14-18	0-2	10-15
HYDROCARBONS								
TOTALS and RATIOS (a)								
Total non-polar hydrocarbon								
Total n-alkanes								
Total isoprenoids								
Non-polar H/C, nC10 to phytane								
Total n-alkanes, nC10-12								
alkanes (nC10-18)/isoprenoids								
trimethyltridecane/nC15								
FTN/alkane*								
Total n-alkane/total nonpolar								
Odd-even predominance								
nC18/phytane								

(a) see notes at beginning of this appendix for details.

Oil Based Muds non-polar hydrocarbon data

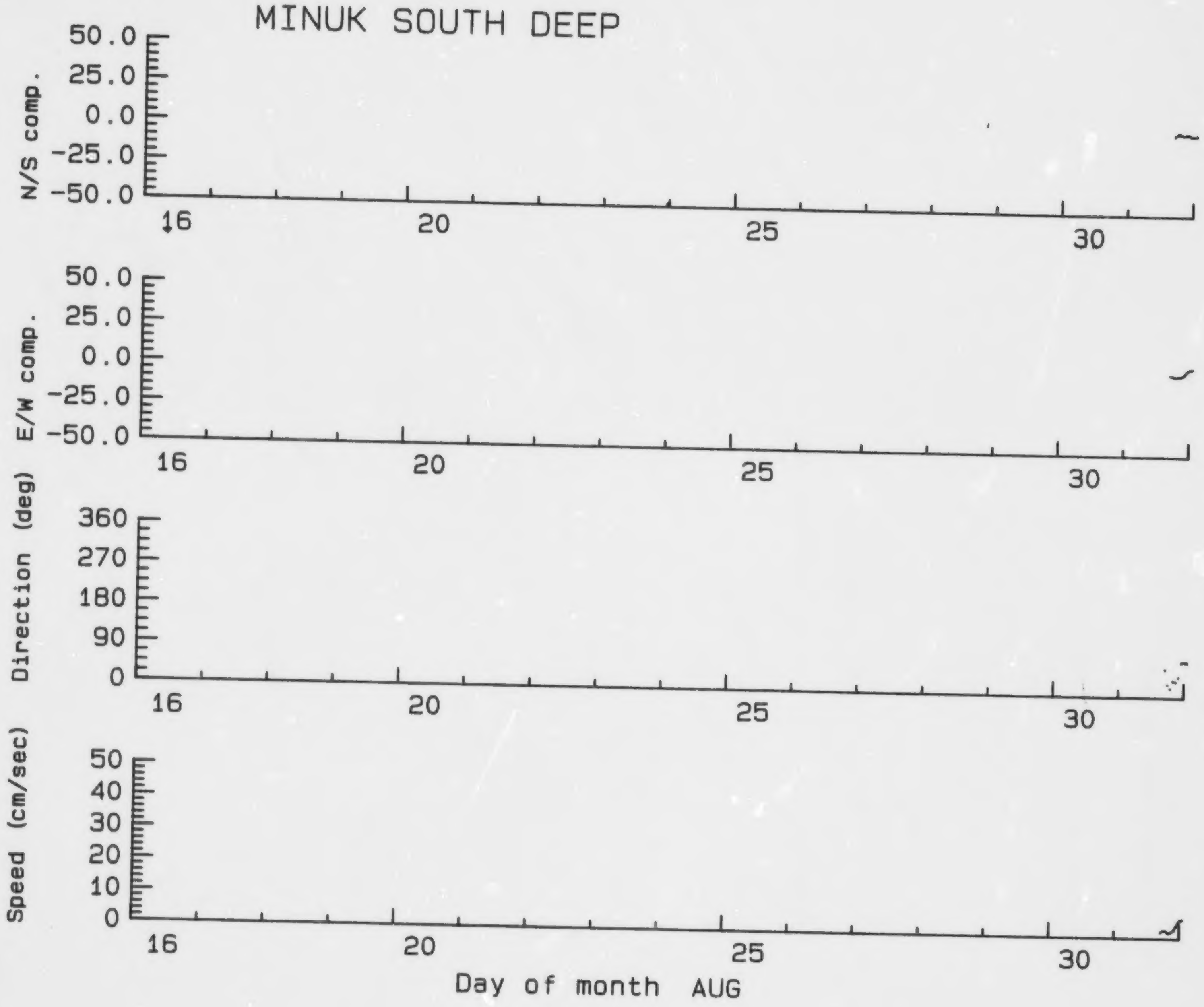
CORE SAMPLES: KAUBVIK I-43, SERIES 6

Sample I.D.	7-04	7-07	7-46	7-45	7-52	7-55	7-36	7-41
Data I.D.	3183/1	3184/1	3186/1	3185/1	3187/1	3192/1	3193/1	3190/1
H/C CONCENTRATIONS (ng/g dry weight basis)								
nC10	<1	170	80	190	49	190	110	150
nC11	250	480	230	570	140	470	31	260
nC12	190	300	140	350	88	290	150	190
Norfarnesane(a)	<1	<0.2	<0.09	53	<0.2	24	36	<0.6
(b)	<1	53	29	72	<0.2	71	45	32
(c)	<1	62	31	74	<0.2	78	47	38
(d)	<1	32	14	33	<0.2	44	24	<0.6
(e)	<1	76	41	95	<0.2	100	70	55
nC13	230	450	230	460	130	360	170	280
Farnesane	<1	130	68	150	63	130	72	89
nC14	300	500	270	580	160	430	200	350
Trimethyl-nC13	220	320	200	410	110	290	160	230
nC15	510	650	370	710	240	510	250	470
nC16	530	590	360	650	220	460	230	450
Norpristane	250	250	160	270	110	210	100	200
nC17	590	630	430	680	280	540	250	490
Pristane	460	580	390	620	240	510	240	460
nC18	400	420	320	440	220	370	170	320
Phytane	250	310	240	320	160	270	130	240
nC19	350	350	300	360	220	300	140	240
nC20	220	290	260	300	190	230	120	170
nC21	270	290	250	290	200	200	110	140
nC22	150	220	210	240	160	150	80	83
nC23	200	250	230	280	190	170	91	88
nC24	<1	170	160	200	140	100	55	44
nC25	<1	220	220	260	160	140	84	52
nC26	<1	110	110	150	88	70	43	<0.6
nC27	<1	250	250	320	210	150	99	66
nC28	<1	83	87	110	67	47	33	<0.6
nC29	<1	160	160	210	130	87	69	41
nC30	<1	42	47	59	37	22	17	<0.6
nC31	<1	88	89	110	77	46	46	38
nC32	<1	17	30	35	20	9	<0.3	<0.6
nC33	<1	29	38	44	27	15	18	<0.7
nC34	<1	11	17	18	21	<0.1	<0.3	<0.7
nC35	<1	10	12	18	14	<0.2	<0.3	<0.7
nC36	<1	<0.2	7	13	30	<0.2	<0.3	<0.8

APPENDIX C

CURRENT METER DATA FOR MINUK I-53; AUGUST 30 - OCTOBER 10, 1985 AND NOVEMBER 1985

```
 Statistics for instrument  5812 tape    2

MINUK SOUTH DEEP               Depth :  14.60     Meter at 6.1 m.

 Total number of records is   936


Temperature (C)                 Mean :  -0.27 std dev. :   0.84 in   936 records
                                Max :    1.17  on day : 260     800
                                Min :   -1.56  on day : 251     500

Salinity (ppt)                  Mean :  25.47 std dev. :   4.65 in   936 records
                                Max :   31.22  on day : 251     400
                                Min :   17.14  on day : 266    1200

Speed (cm/sec)                  Mean :  13.58 std dev. :   9.97 in   936 records
                                Max :   56.38  on day : 260     800
                                Min :    0.64  on day : 256     800

Direction (deg)                 Mean : 170.63 std dev. : 108.10 in   936 records
                                Max :  359.80  on day : 265     200
                                Min :    0.20  on day : 270    1200

E/W comp.                       Mean :   0.50 std dev. :  11.34 in   936 records
                                Max :   50.18  on day : 261     500
                                Min :  -33.13  on day : 266    1900

N/S comp.                       Mean :   2.42 std dev. :  12.21 in   936 records
                                Max :   55.69  on day : 260     200
                                Min :  -24.62  on day : 252    1000

 Mean velocity magnitude (cm/s) is :   2.48
 Mean direction is :  11.59 (deg)
```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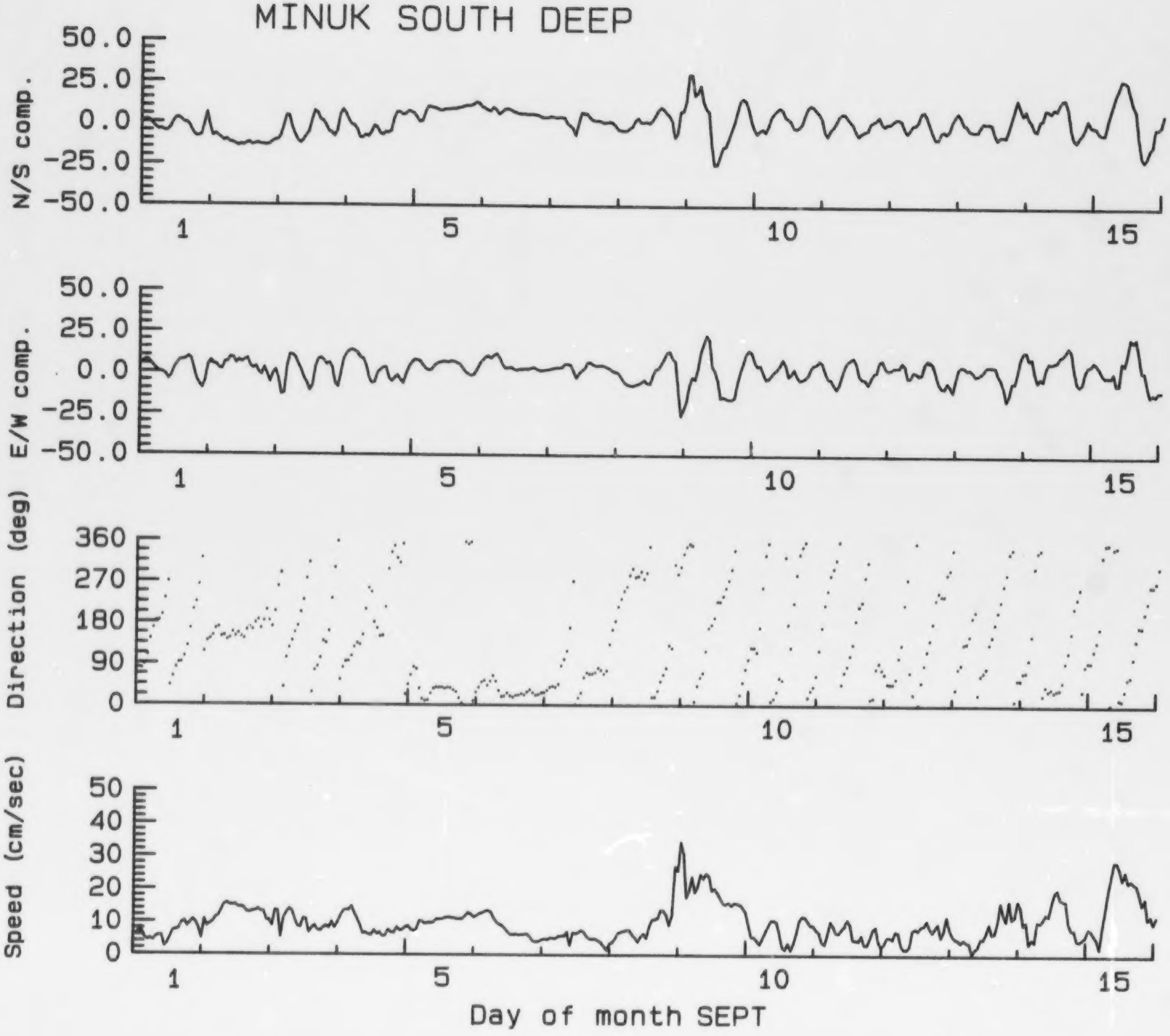
25.0
0.0
-25.0
-50.0
E/W comp.
50.0
25.0
0.0
-25.0
-50.0
Direction (deg)
360
270
180
90
0
Speed (cm/sec)
50
40
30
20
10
0
16
20
25
30
Day of month AUG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25.0
0.0
-25.0
-50.0
1
5
10
15
E/W comp.
50.0
25.0
0.0
-25.0
-50.0
1
5
10
15
Direction (deg)
360
270
180
90
0
1
5
10
15
Speed (cm/sec)
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40
30
20
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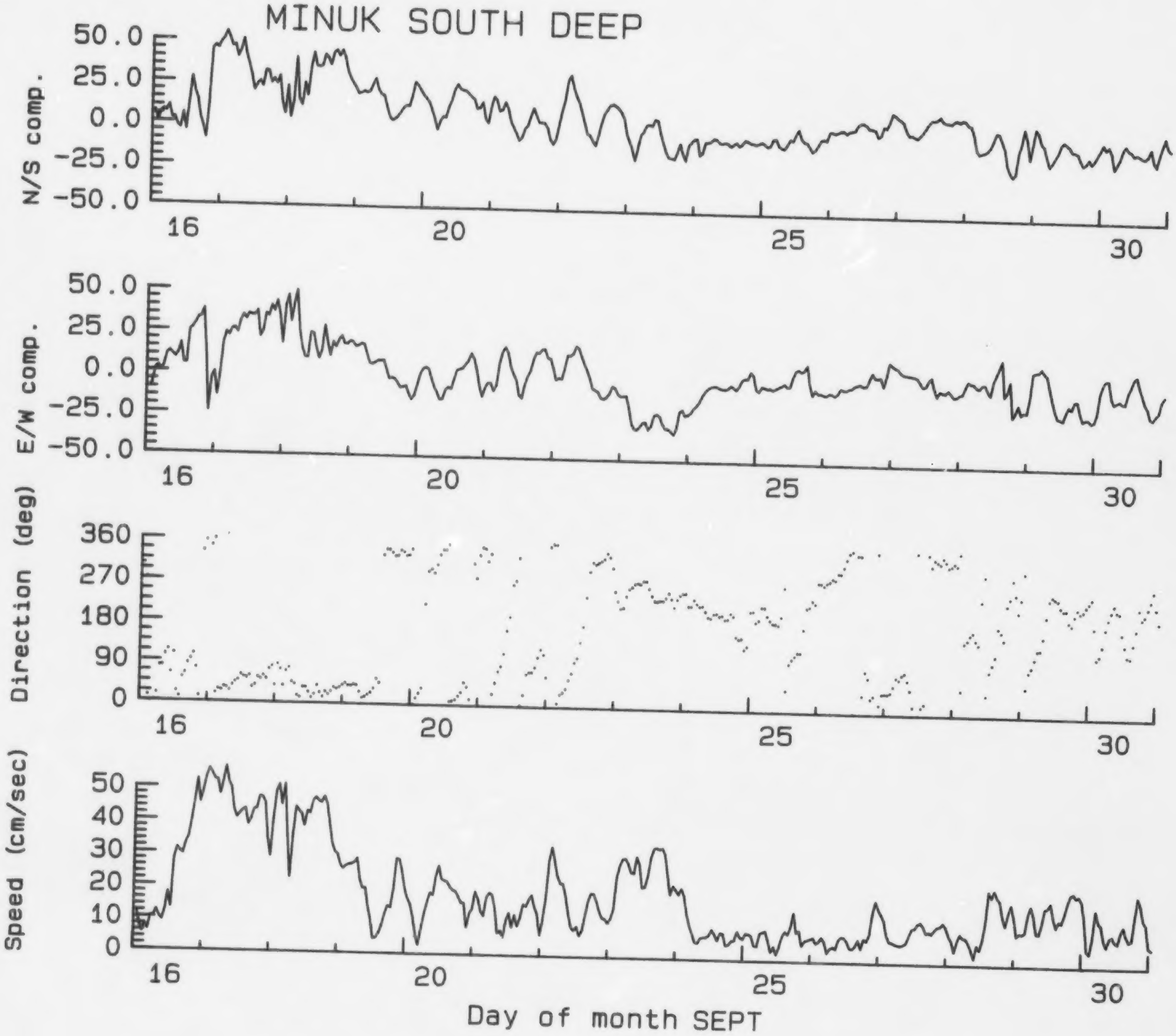
1
5
10
15
Day of month SEPT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0.0
-25.0
-50.0
E/W comp.
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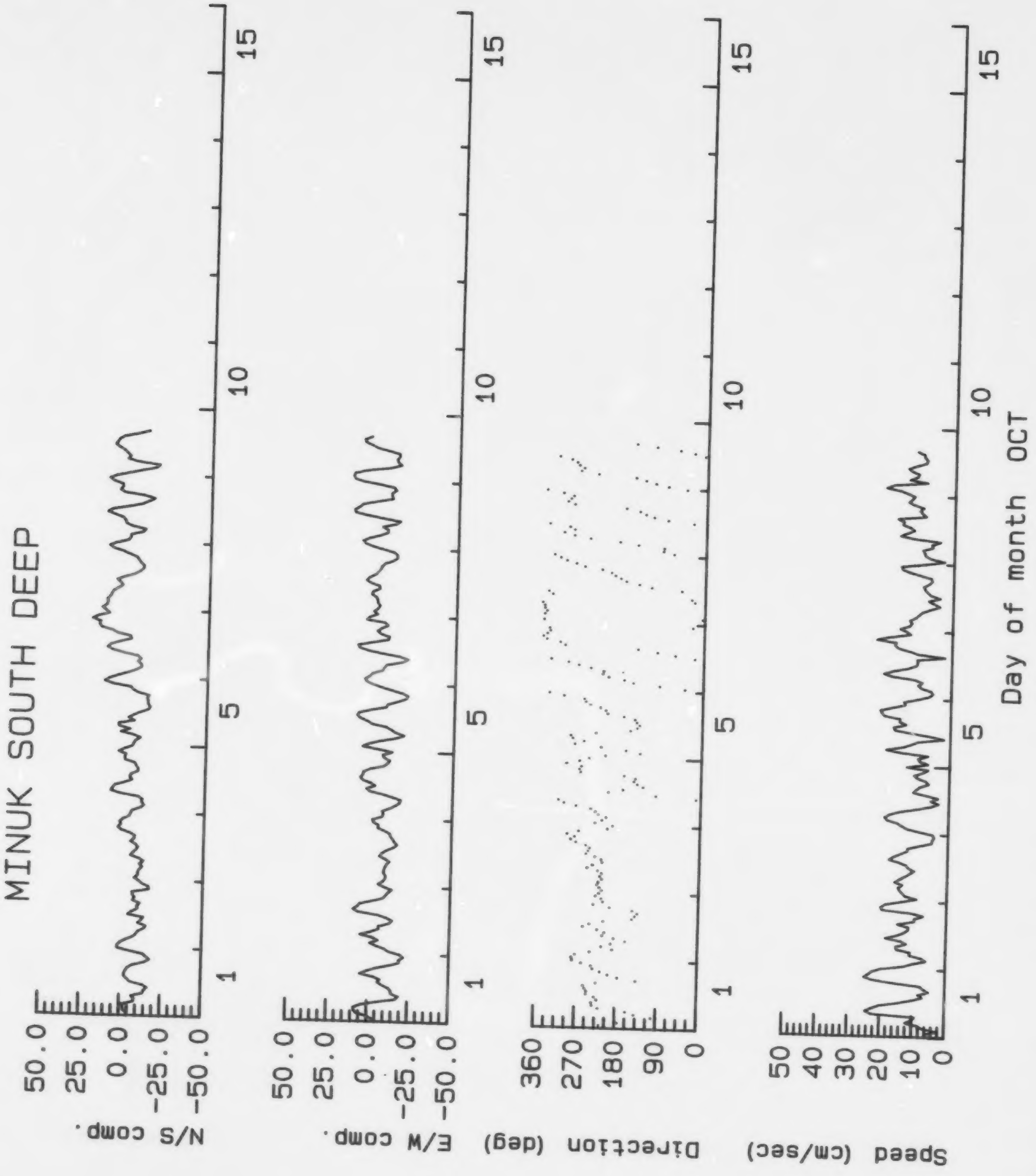
25.0
0.0
-25.0
-50.0
Direction (deg)
360
270
180
90
0
Speed (cm/sec)
50
40
30
20
10
0
16
20
25
30
Day of month SEPT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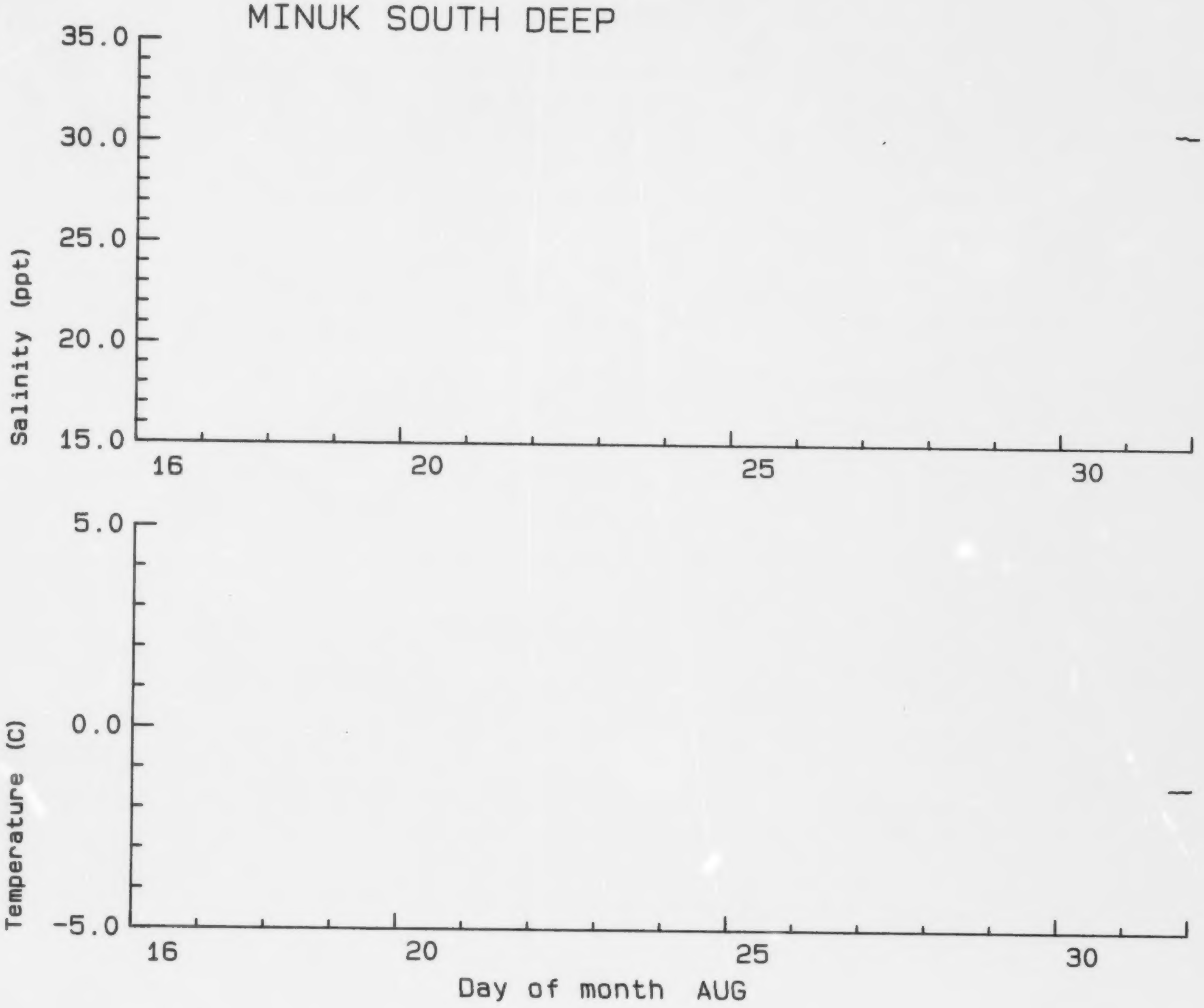
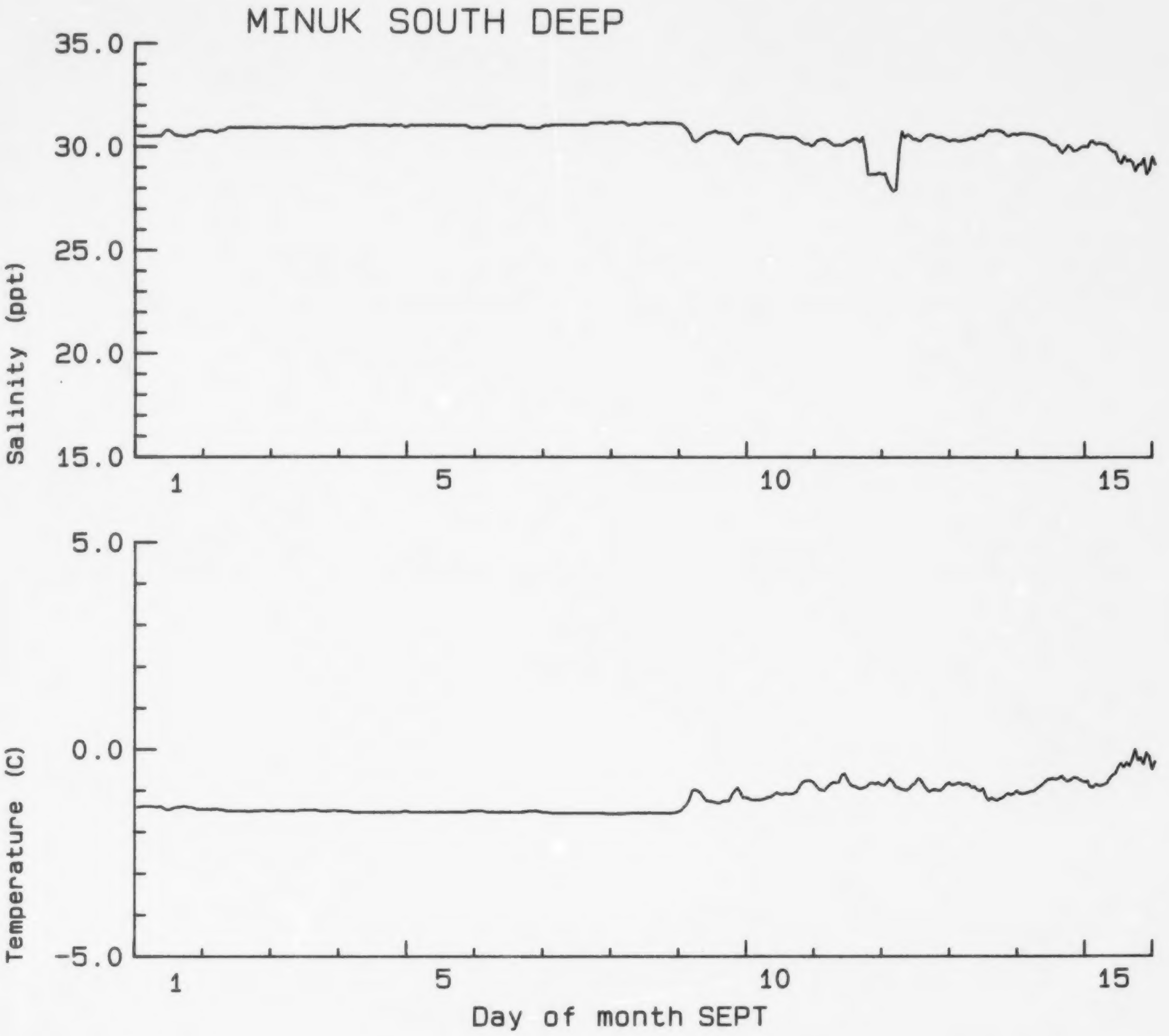
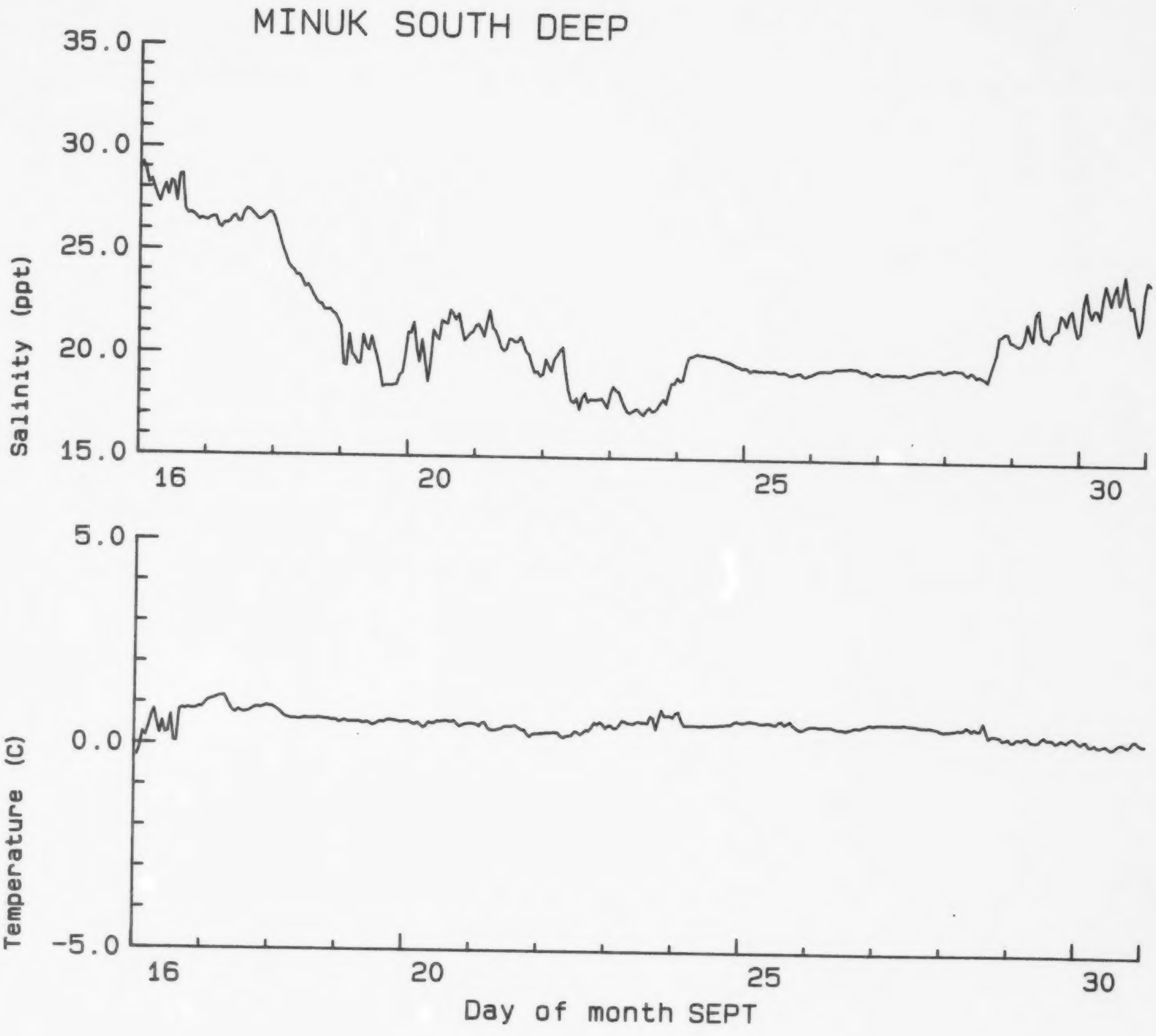
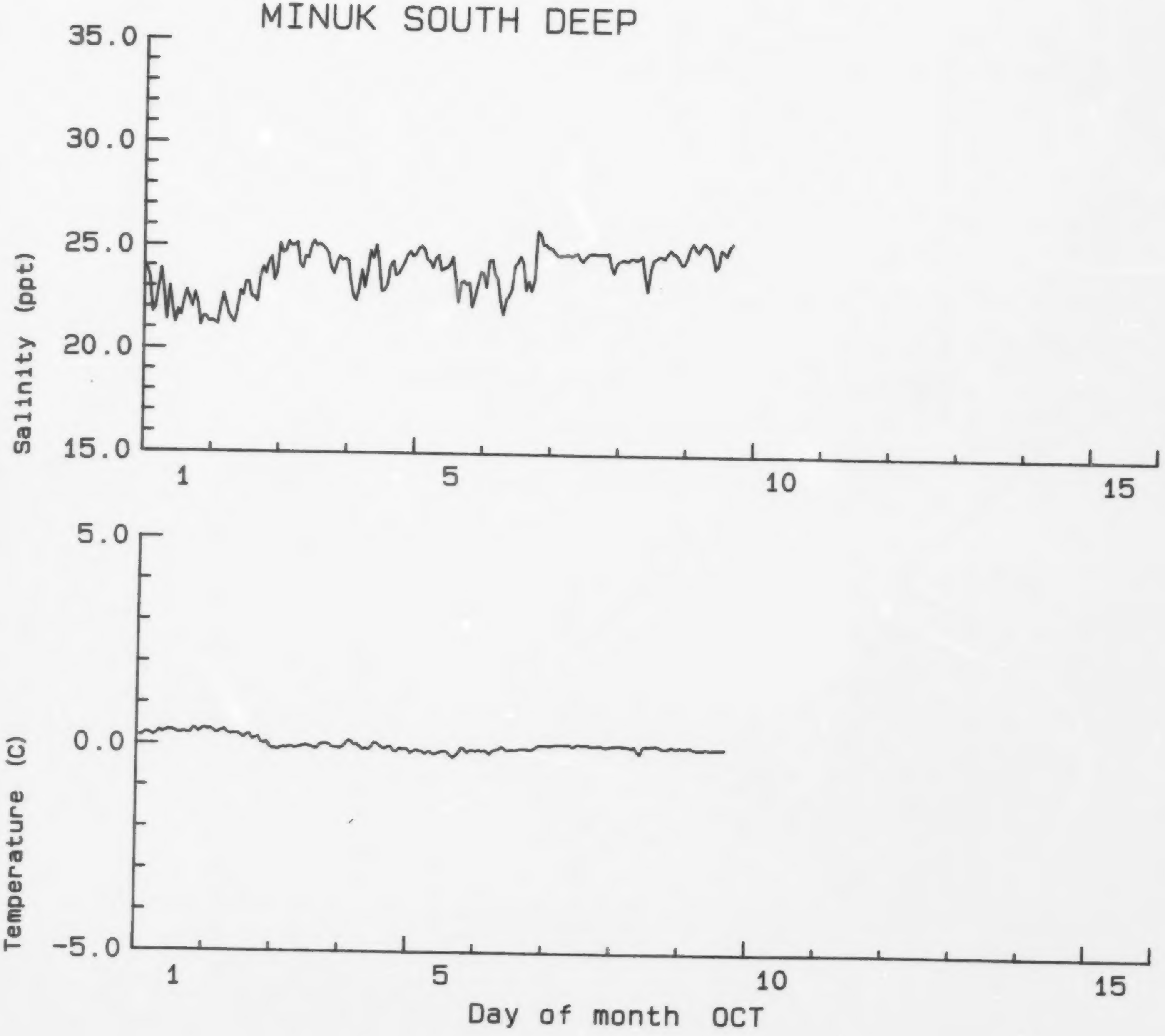
N/S comp.
50.0
25.0
0.0
-25.0
-50.0
E/W comp.
50.0
25.0
0.0
-25.0
-50.0
Direction (deg)
360
270
180
90
0
Speed (cm/sec)
50
40
30
20
10
0
1
5
10
15
Day of month OCT

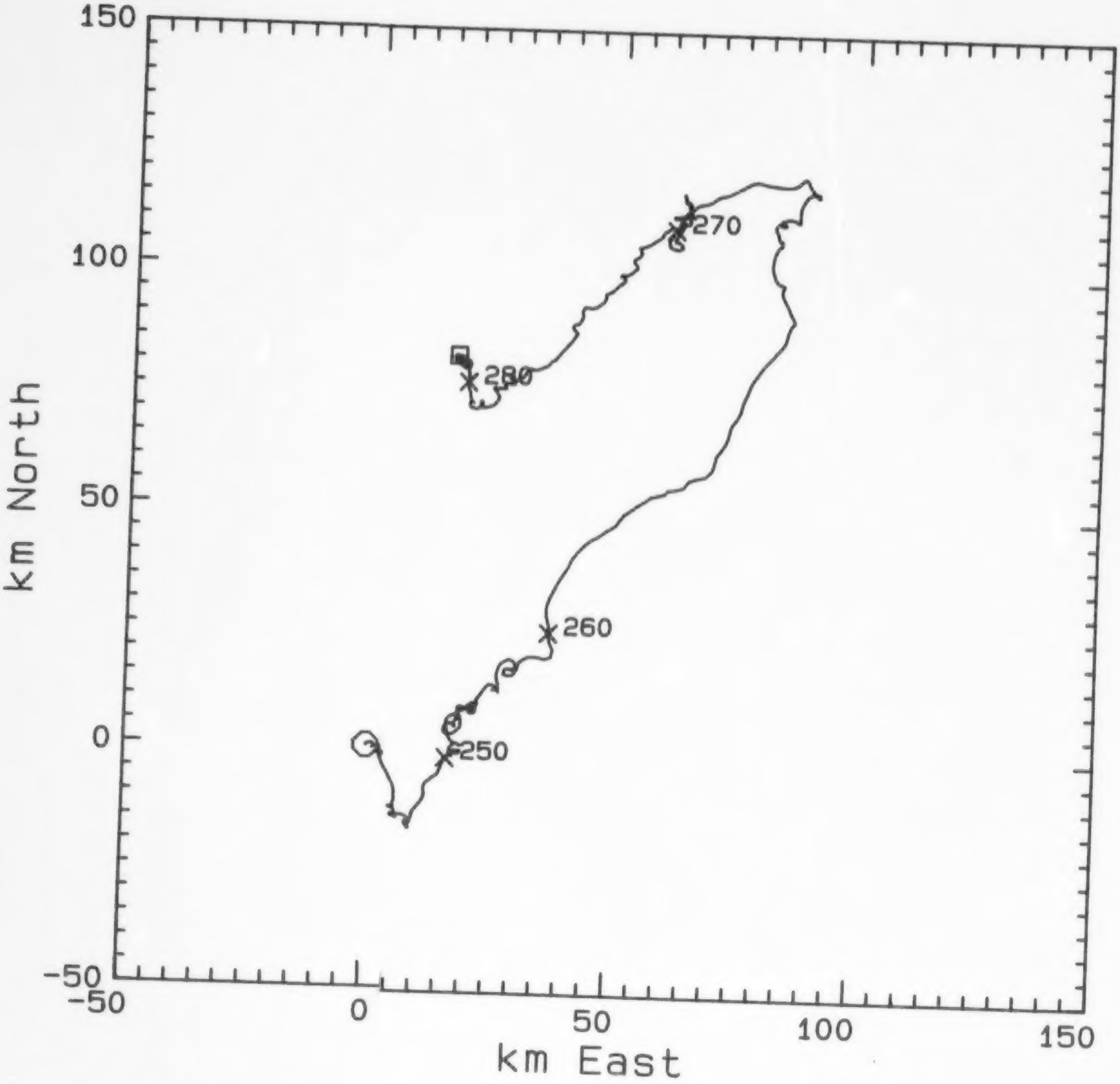


MINUK SOUTH DEEP


MINUK SOUTH DEEP
Salinity (ppt)
35.0
30.0
25.0
20.0
15.0
1
5
10
15
Temperature (C)
5.0
0.0
-5.0
1
5
10
15
Day of month SEPT


MINUK SOUTH DEEP
Salinity (ppt)
35.0
30.0
25.0
20.0
15.0
16
20
25
30
Temperature (C)
5.0
0.0
-5.0
16
20
25
30
Day of month SEPT

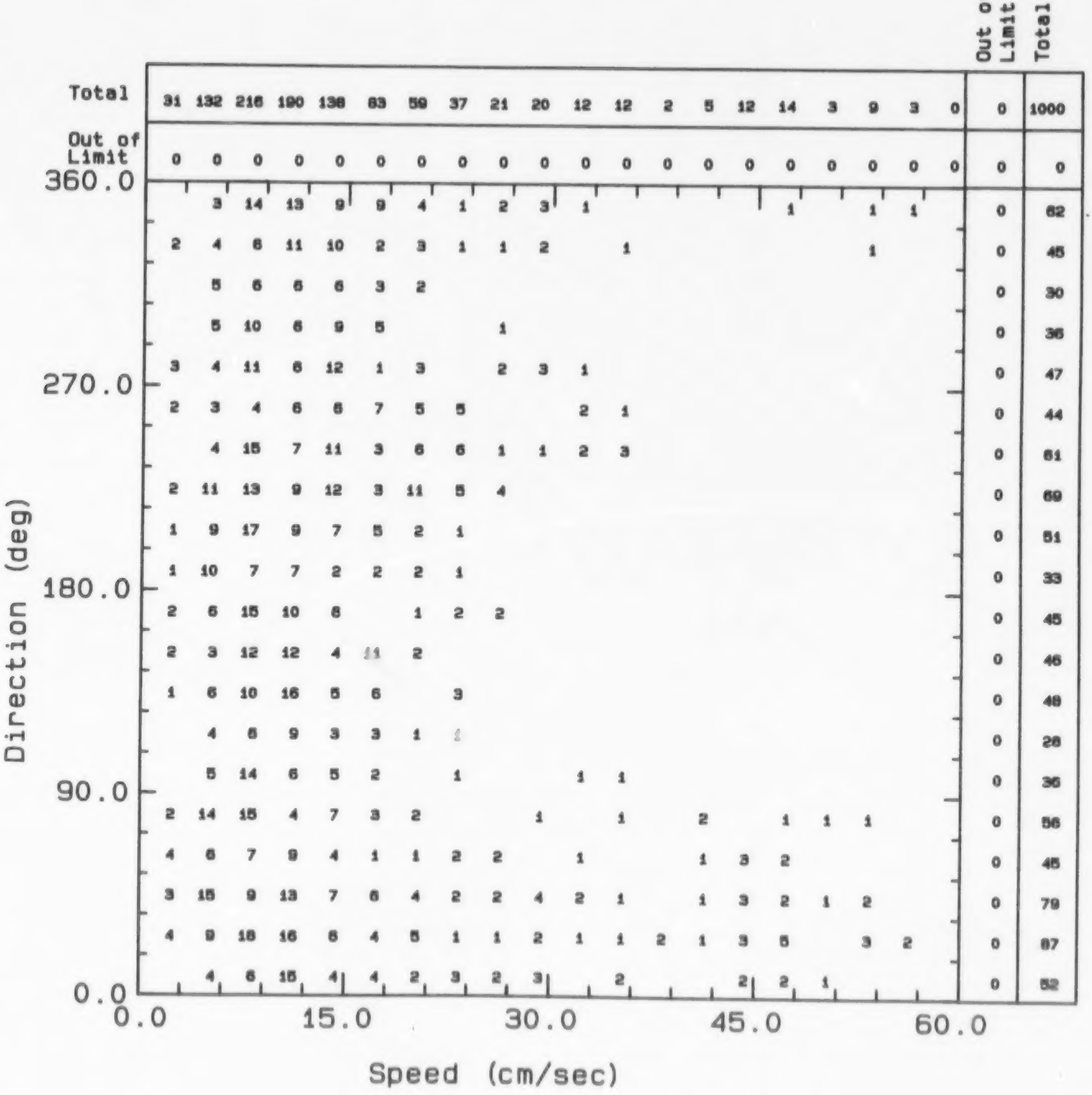

MINUK SOUTH DEEP
Salinity (ppt)
35.0
30.0
25.0
20.0
15.0
1
5
10
15
Temperature (C)
5.0
0.0
-5.0
1
5
10
15
Day of month OCT



Progressive vector diagram of :
Low pass filtered data
For :
MINUK SOUTH DEEP
From hour 1700 Day 243
Instrument 5812 Tape 2
Depth 14.6 m

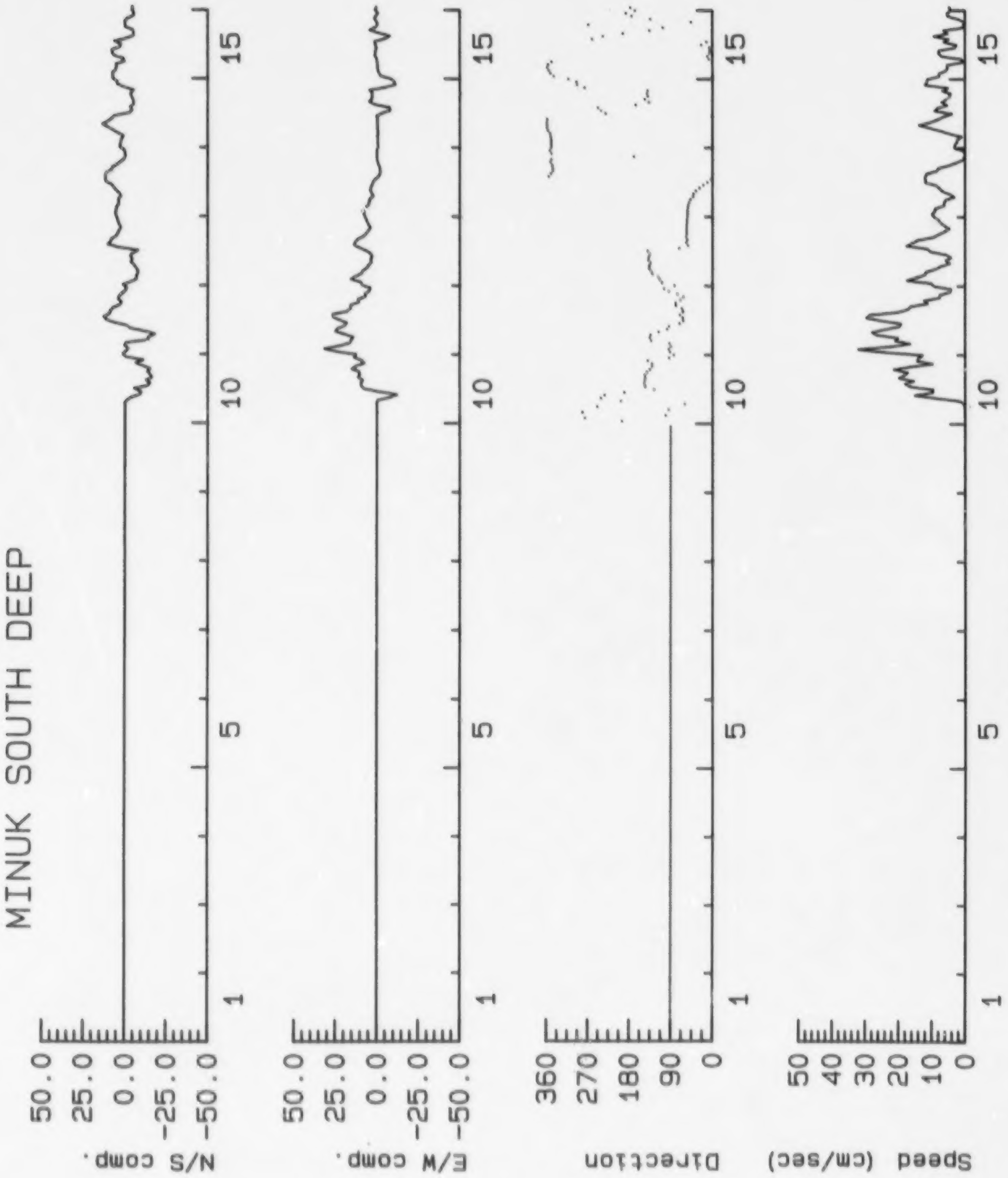
MINUK SOUTH DEEP

Number of samples 936

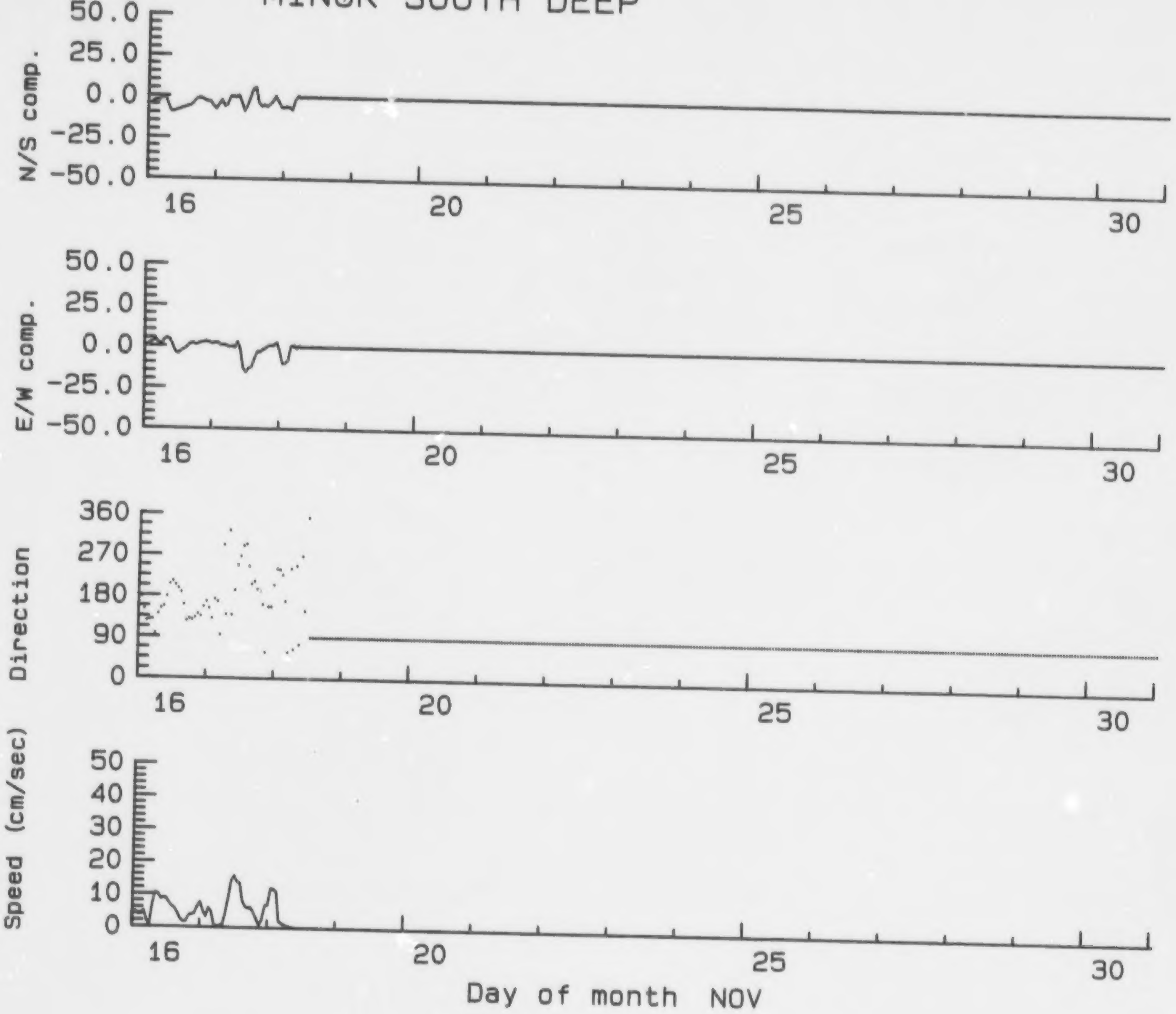


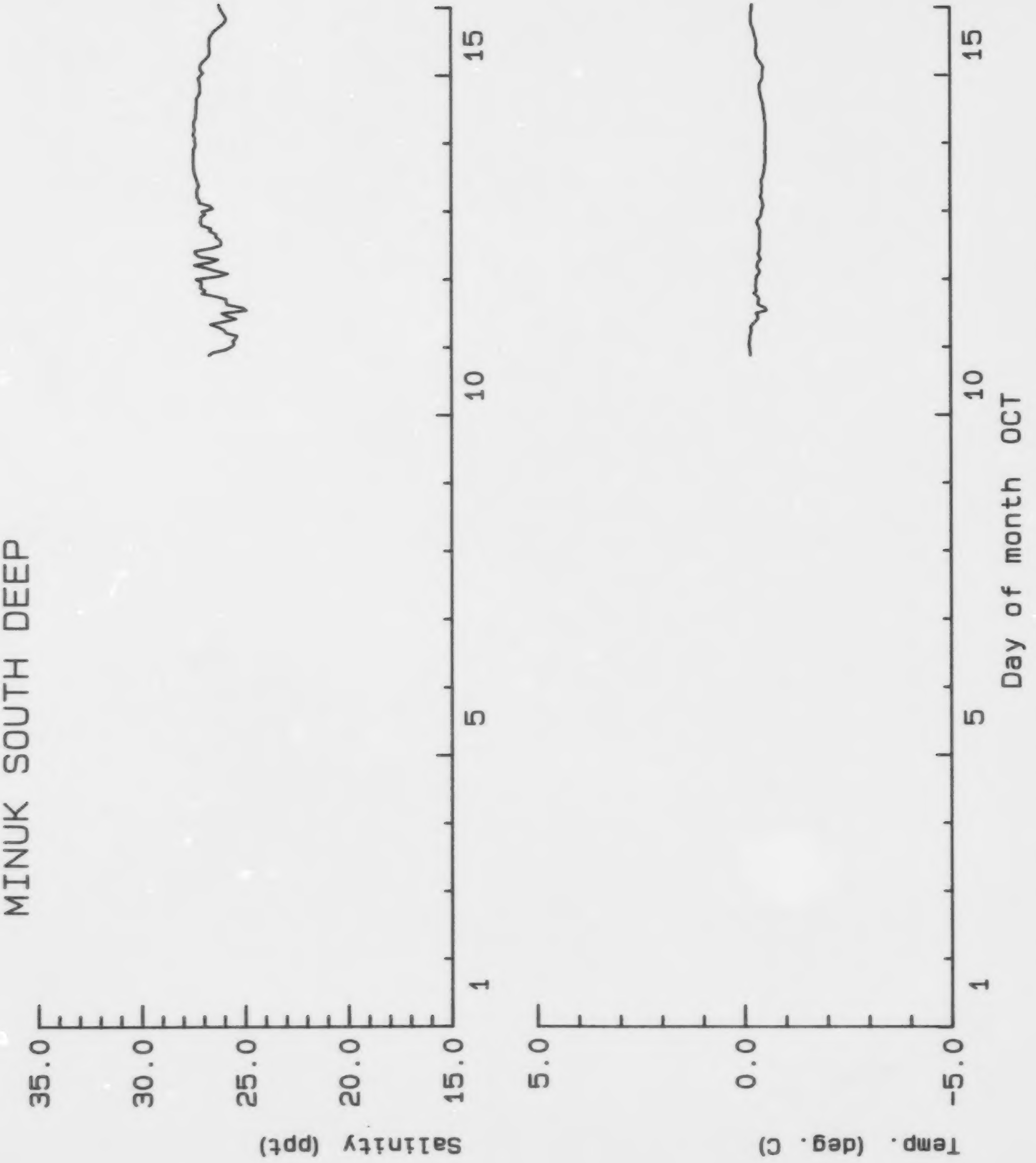
																					Out of Limit	Total
Total	31	132	216	190	138	83	59	37	21	20	12	12	2	5	12	14	3	9	3	0	0	1000
Out of Limit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		3	14	13	9	9	4	1	2	3	1					1		1	1		0	62
	2	4	6	11	10	2	3	1	1	2		1						1			0	45
		5	6	6	6	3	2														0	30
		5	10	6	9	5			1												0	36
	3	4	11	6	12	1	3		2	3	1										0	47
	2	3	4	6	6	7	5	5			2	1									0	44
		4	15	7	11	3	6	6	1	1	2	3									0	61
	2	11	13	9	12	3	11	5	4												0	69
	1	9	17	9	7	5	2	1													0	51
	1	10	7	7	2	2	2	1													0	33
	2	6	15	10	6		1	2	2												0	45
	2	3	12	12	4	11	2														0	46
	1	6	10	16	5	6		3													0	48
		4	6	9	3	3	1	1													0	28
		5	14	6	5	2		1			1	1									0	36
	2	14	15	4	7	3	2			1		1		2		1	1	1			0	56
	4	6	7	9	4	1	1	2	2		1			1	3	2					0	45
	3	15	9	13	7	6	4	2	2	4	2	1		1	3	2	1	2			0	79
	4	9	18	16	6	4	5	1	1	2	1	1	2	1	3	5		3	2		0	87
		4	6	15	4	4	2	3	2	3		2			2	2	1				0	52

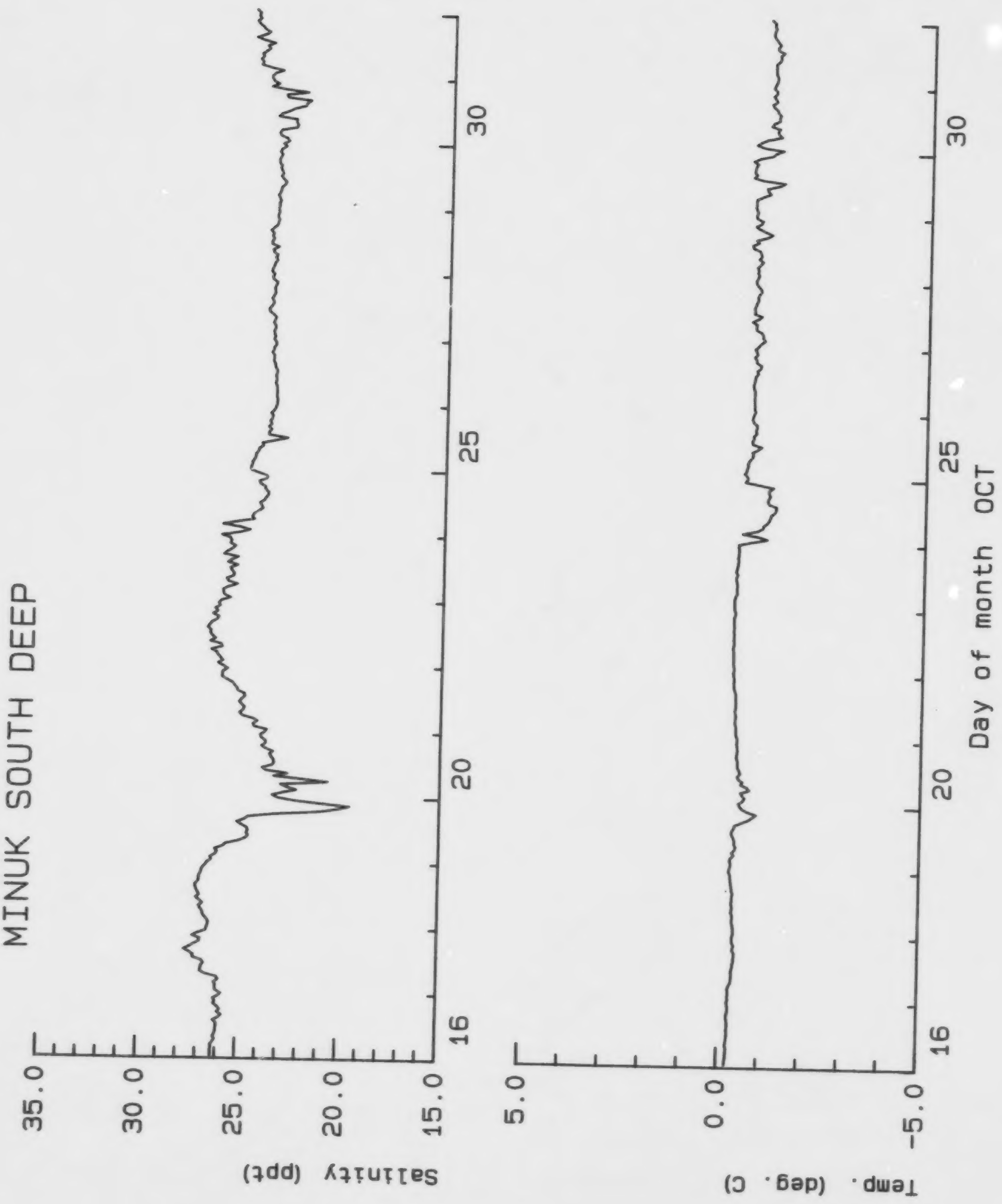
```
  Statistics for instrument  5812 tape    0

 MINUK SOUTH DEEP                Depth :  13.00


  Total number of records is   160


 Temp. (deg. C)              Mean :  -1.21 std dev. :   0.07 in   160 records
                             Max :   -0.91  on day : 315      0
                             Min :   -1.26  on day : 321   1000

 Salinity (ppt)              Mean :  22.89 std dev. :   0.76 in   160 records
                             Max :   25.52  on day : 315    600
                             Min :   19.31  on day : 315    300

 Speed (cm/sec)              Mean :   8.43 std dev. :   6.44 in   160 records
                             Max :   32.20  on day : 315    200
                             Min :    0.04  on day : 317   2200

 Direction                   Mean : 161.74 std dev. : 108.86 in   160 records
                             Max :  359.10  on day : 318    900
                             Min :    0.70  on day : 318   1100

 E/W comp.                   Mean :   3.68 std dev. :   7.94 in   160 records
                             Max :   32.13  on day : 315    200
                             Min :  -15.75  on day : 321   1200

 N/S comp.                   Mean :   0.51 std dev. :   5.97 in   160 records
                             Max :   13.77  on day : 318    800
                             Min :  -18.16  on day : 315    700

 Mean velocity magnitude (cm/s) is :   3.71
 Mean direction is :  82.11 (deg)
```


MINUK SOUTH DEEP
N/S comp.
50.0
25.0
0.0
-25.0
-50.0
E/W comp.
50.0
25.0
0.0
-25.0
-50.0
Direction
360
270
180
90
0
Speed (cm/sec)
50
40
30
20
10
0
1
5
10
15
Day of month NOV

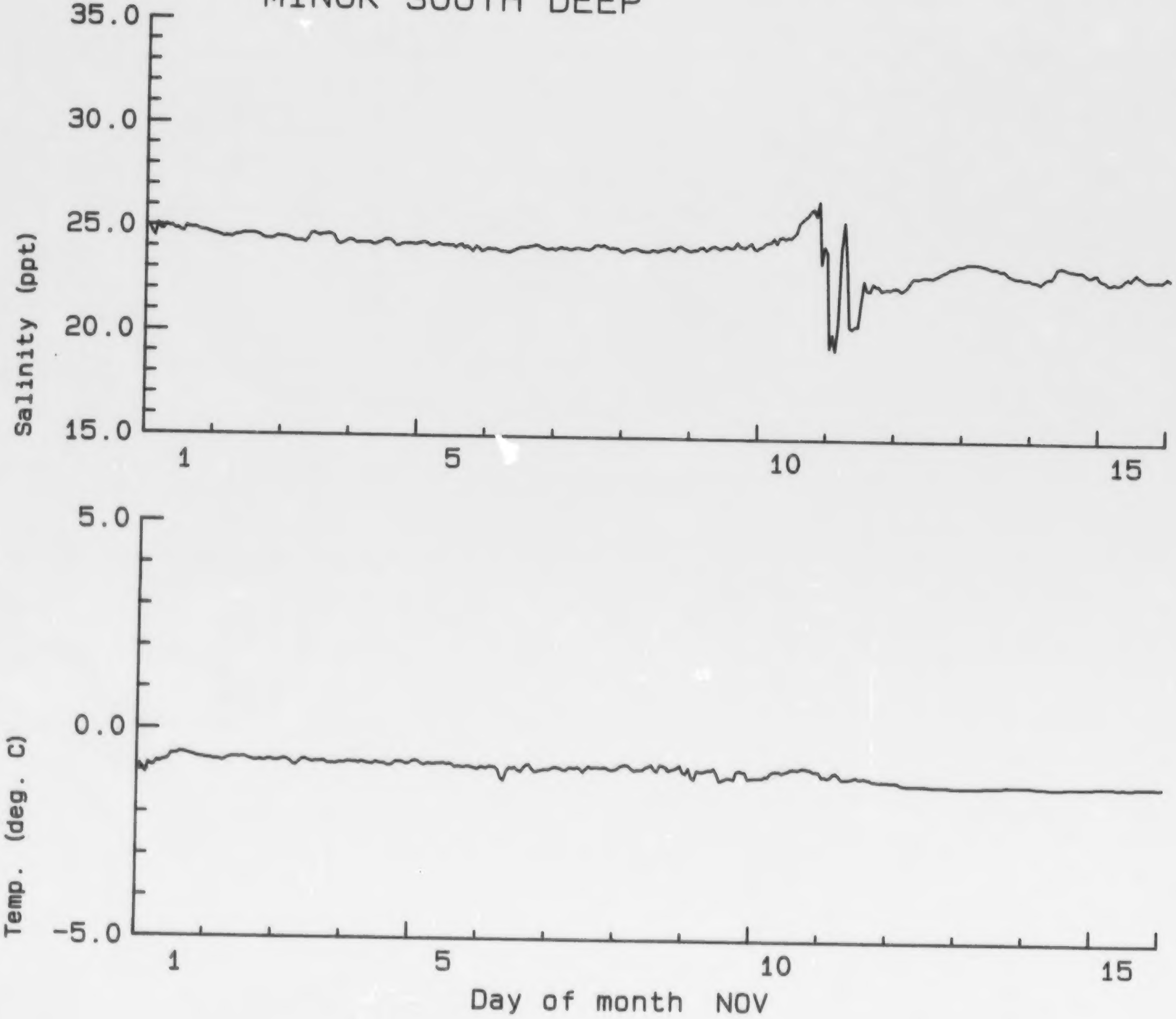
MINUK SOUTH DEEP

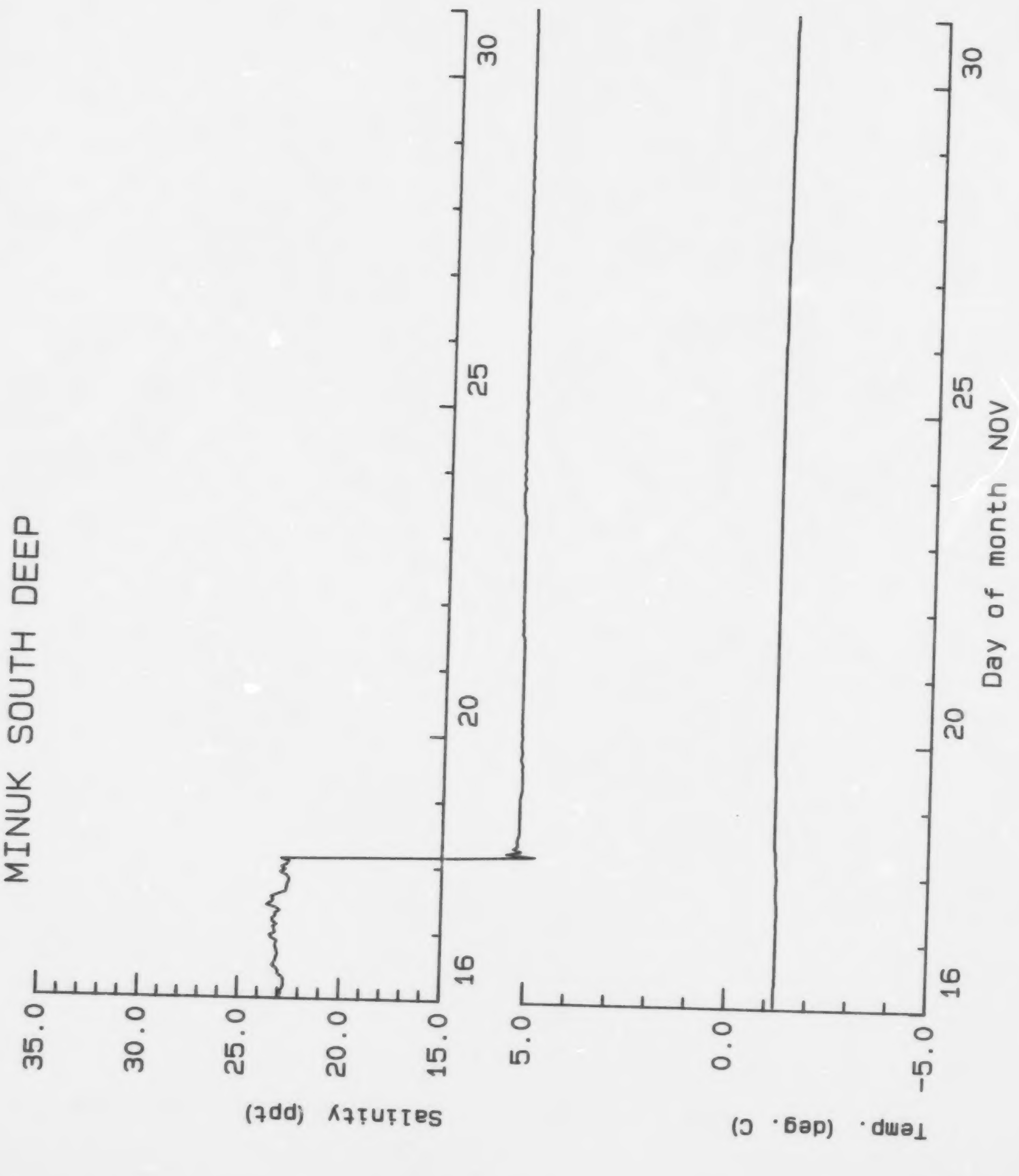


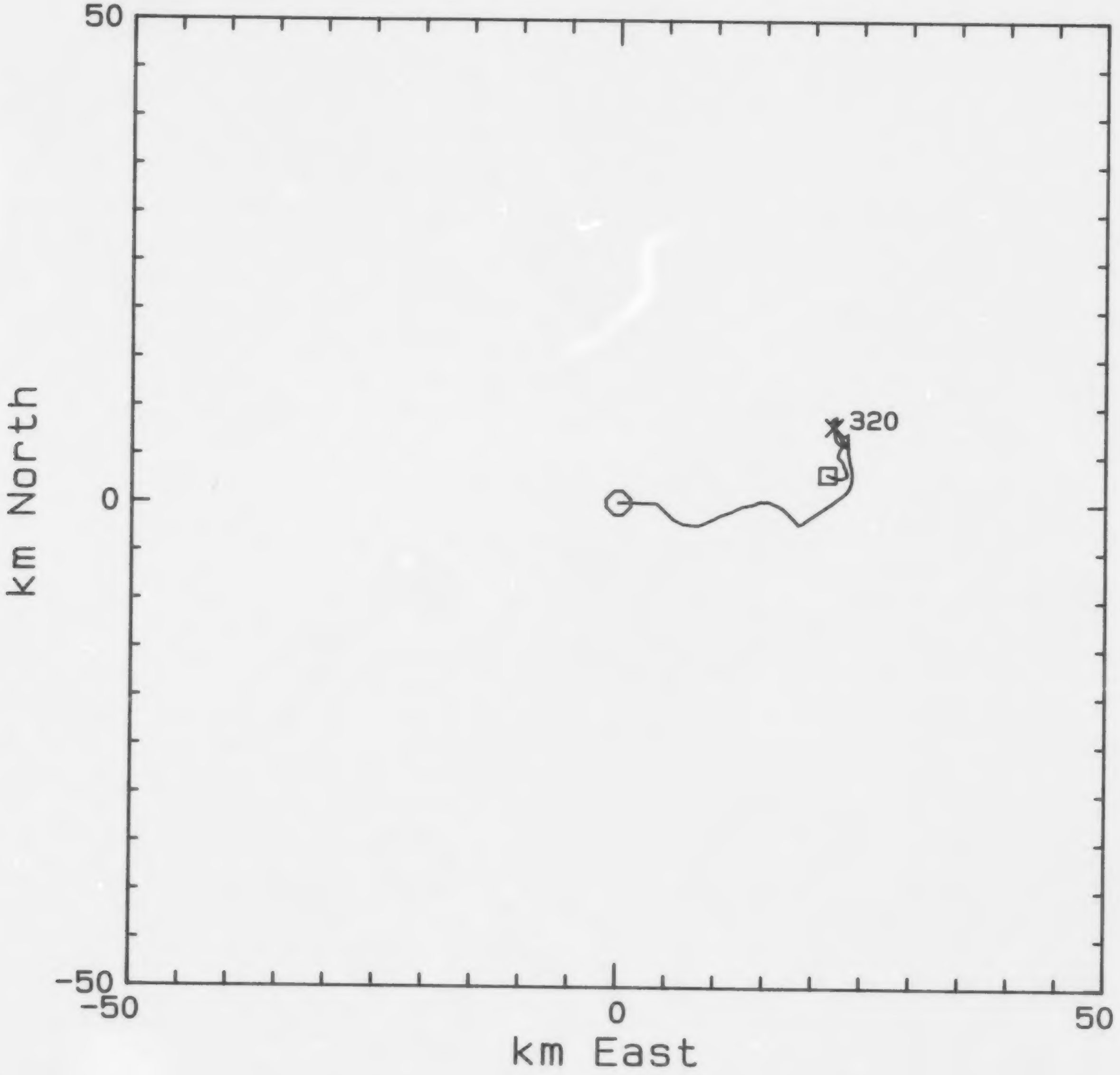

MINUK SOUTH DEEP
Salinity (ppt)
35.0
30.0
25.0
20.0
15.0
Temp. (deg. C)
5.0
0.0
-5.0
1
5
10
15
Day of month OCT


MINUK SOUTH DEEP
Salinity (ppt)
35.0
30.0
25.0
20.0
15.0
Temp. (deg. C)
5.0
0.0
-5.0
16
20
25
30
Day of month OCT

MINUK SOUTH DEEP



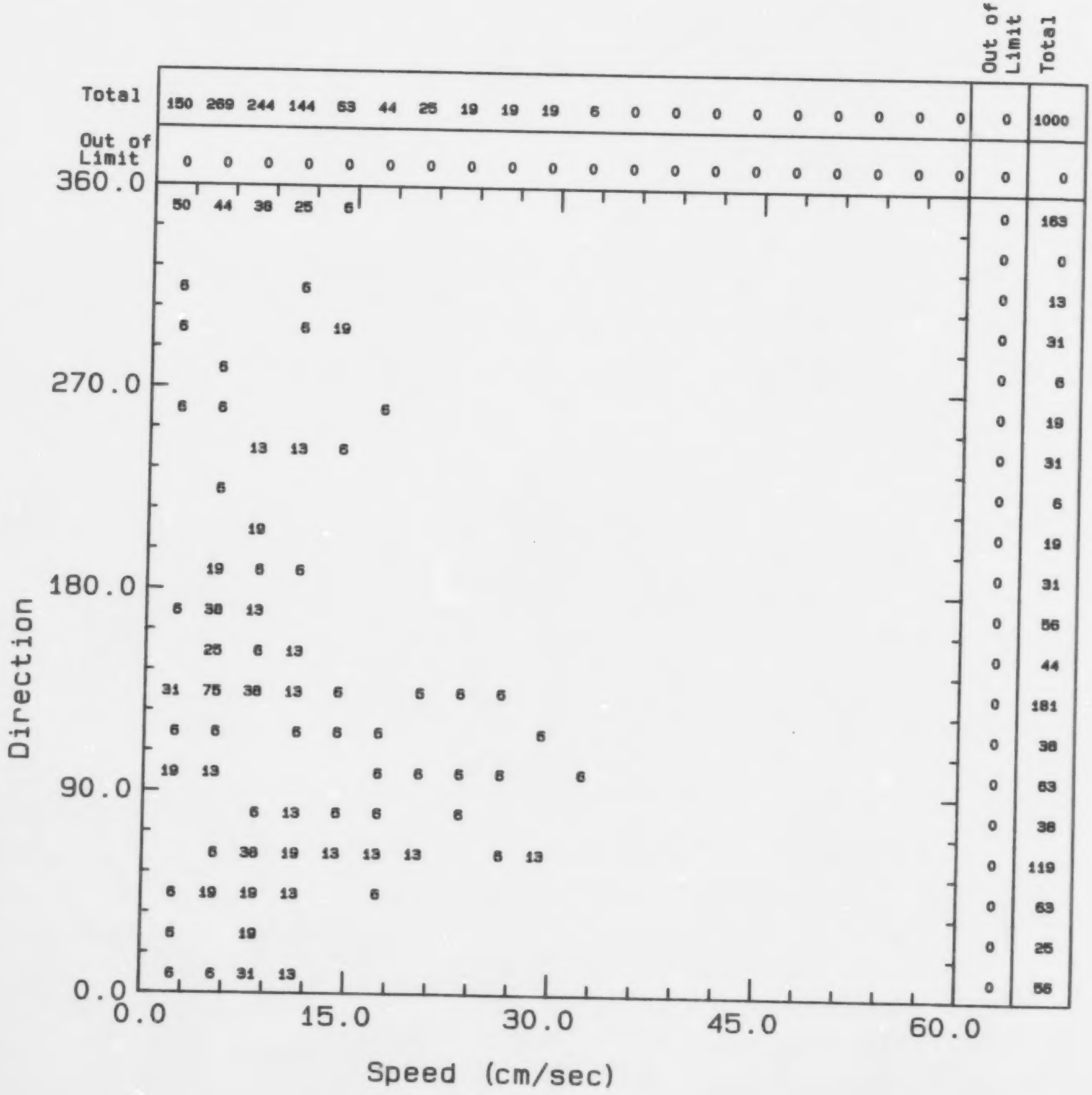

MINUK SOUTH DEEP
Salinity (ppt)
35.0
30.0
25.0
20.0
15.0
Temp. (deg. C)
5.0
0.0
-5.0
16
20
25
30
Day of month NOV



Progressive vector diagram of :
Low pass filtered data
For :
MINUK SOUTH DEEP
From hour 0 Day 315
Instrument 5812 Tape 0
Depth 13.0 m

MINUK SOUTH DEEP

Number of samples 160



APPENDIX D

SUMMARY OF PAH ANALYSES OF 25 SELECTED SAMPLES FROM KAUBVIK I-43 AND MINUK I-53.

Notes for PAH appendix data.

The concentration of individual parent PAH, total alkyl homologue groups and total PAH in selected samples are given in ng/g, dryweight basis in the following appendix. Alkylated PAH derivatives are denoted by the number of methyl equivalents for that alkyl (i.e a C3-naphthalene is the total of the trimethyl-, the dimethylethyl-, the propyl- and the isopropyl-naphthalenes). Samples are presented by sample series.

Three ratios are included with each sample to sense changes in source of PAH. The **alkyl homologue distribution (AHD)** is the ratio of each alkyl homologue concentration to the parent PAH concentration and is calculated for naphthalene (**Naph AHD**) and phenanthrene/anthracene (**Phen AHD**).

The **parent compound disribution (PCD)** is the ratio of the parent PAH groups to phenanthrene + anthracene.

Polycyclic aromatic hydrocarbon concentrations

Sample I.D.	1-01	1-04	1-09	1-10	1-12	1-17	1-20	1-26	1-30	1-33
Data I.D.	30/1	40/1	32/1	33/1	34/1	35/1	42/1	41/1	26/1	27/1
Naphthalene	1.8	2.3	9.8	2.3	6.4	16.7	23.1	66.5	53.3	53.4
C1-Naphthalene	4.3	8.1	39.2	8.0	24.6	62.6	76.8	177.9	213.4	200.7
Fluorene	0.8	1.2	3.7	0.9	2.7	5.9	6.5	14.7	16.8	3.3
C2-Naphthalene	8.8	25.5	42.3	16.9	53.5	125.7	25.3	754.7	939.2	459.5
C3-Naphthalene	5.1	29.3	30.9	12.3	34.3	72.4	163.2	483.1	1106.7	283.6
C4-Naphthalene	4.5	10.1	24.3	15.3	35.0	73.1	63.2	188.2	1213.0	238.9
Dibenzothiophene	0.4	1.3	2.0	0.6	2.0	4.4	5.1	12.1	15.6	11.6
Phenanthrene	4.1	7.6	22.0	6.8	15.1	33.8	48.5	102.6	127.8	118.9
Anthracene	0.3	1.6	1.7	0.5	0.9	0.7	0.1	0.1	0.1	5.1
C1-Dibenzothiophene	0.8	1.9	4.9	1.9	4.8	11.3	7.6	17.8	36.4	25.8
C1-Phenanthrene/Anthracene	11.1	23.9	63.0	22.8	44.9	102.5	124.3	274.7	338.2	297.0
Fluoranthene	1.5	2.5	5.6	2.9	5.0	8.8	7.7	18.1	24.9	22.6
Pyrene	3.0	4.5	10.3	5.1	8.4	15.5	13.4	30.6	40.7	40.1
C2-Dibenzothiophene	0.5	1.2	2.1	1.1	2.6	7.0	6.0	14.2	20.2	21.8
C2-Phenanthrene/Anthracene	8.7	20.1	49.6	17.4	37.3	80.7	105.5	232.6	260.1	279.5
C3-Phenanthrene/Anthracene	9.2	12.4	41.7	19.3	31.6	66.6	41.9	92.1	193.5	174.2
Benz(a)anthracene	0.7	2.1	2.7	0.9	2.0	4.0	3.3	6.6	6.8	6.2
Chrysene	3.0	6.3	12.8	4.3	9.2	19.4	25.9	58.2	43.1	37.9
C4-Phenanthrene/Anthracene	2.8	1.9	14.1	0.6	11.2	22.2	10.2	29.6	64.7	58.6
Benzofluoranthenes	4.1	3.9	17.1	9.4	12.2	24.2	21.6	47.9	54.6	75.5
Benzo(e)pyrene	11.0	4.1	18.2	6.7	11.4	28.0	33.7	65.6	84.4	104.0
Benzo(a)pyrene	9.2	2.7	4.2	1.7	3.5	6.7	8.0	16.1	35.2	25.1
Perylene	0.0	39.1	51.1	38.2	44.2	73.1	97.9	199.9	200.9	254.2
Total	95.7	213.4	473.4	195.8	403.0	875.1	918.8	2903.8	5089.8	2797.6
Naphthalene AHD										
C0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C1	2.38	3.54	3.99	3.43	3.81	3.75	3.32	2.68	4.00	3.75
C2	4.88	11.19	4.31	7.24	8.30	7.53	1.09	11.35	17.61	8.60
C3	2.83	12.87	3.14	5.28	5.32	4.33	7.06	7.26	20.75	5.31
C4	2.52	4.44	2.47	6.56	5.44	4.38	2.73	2.83	22.74	4.47
Phenanthrene/anthracene AHD										
C0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C1	2.52	2.62	2.66	3.14	2.80	2.97	2.55	2.67	2.65	2.40
C2	1.96	2.20	2.10	2.39	2.32	2.63	2.17	2.27	2.03	2.25
C3	2.08	1.36	1.76	2.65	1.97	1.93	0.86	0.90	1.51	1.41
C4	0.63	0.21	0.59	0.08	0.70	0.65	0.21	0.29	0.51	0.47
Parent Compound Distribution (PCD)										
Naph	0.41	0.25	0.42	0.32	0.40	0.48	0.48	0.65	0.42	0.43
Fluor	0.18	0.13	0.16	0.13	0.17	0.17	0.13	0.14	0.13	0.03
DBT	0.08	0.14	0.08	0.08	0.13	0.13	0.10	0.12	0.12	0.09
Phen	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Pyr	1.02	0.77	0.67	1.10	0.84	0.71	0.43	0.47	0.51	0.51
BaA	0.82	0.92	0.65	0.71	0.70	0.68	0.60	0.63	0.39	0.36
BF/BP	0.92	4.72	2.88	6.55	3.52	2.82	2.46	2.41	2.00	2.66

Polycyclic aromatic hydrocarbon concentrations

Sample I.D.	2-01	2-04	2-09	2-10	2-12	2-19	2-22	2-26	2-32	2-33	2-36
Data I.D.	46/1	47/1	49/1	45/1	61/1	52/1	62/1	48/1	53/1	54/1	63/1
Naphthalene	7.2	8.9	55.3	27.5	8.4	25.1	61.2	67.2	62.7	44.8	17.9
C1-Naphthalene	18.6	16.3	197.9	98.0	27.4	96.1	228.8	226.7	233.7	183.9	67.4
Fluorene	2.8	4.5	31.5	11.1	2.3	10.7	23.0	31.8	20.4	13.0	5.7
C2-Naphthalene	45.3	34.4	440.3	241.2	54.6	185.1	415.9	529.7	467.9	476.3	115.3
C3-Naphthalene	32.7	28.9	270.5	164.5	71.6	104.5	577.6	324.9	262.2	334.1	224.6
C4-Naphthalene	9.0	7.3	93.9	59.8	61.9	37.5	383.4	121.7	121.1	152.3	151.1
Dibenzothiophene	1.7	2.0	17.7	5.2	2.0	6.1	15.8	19.4	15.8	13.2	4.4
Phenanthrene	18.9	34.0	170.5	81.5	14.7	60.6	115.4	204.6	141.5	112.4	28.9
Anthracene	0.1	8.7	15.4	0.2	0.9	0.1	4.3	14.8	0.2	0.1	1.4
C1-Dibenzothiophene	4.4	3.2	37.4	17.9	2.9	16.5	22.7	49.0	39.0	30.4	7.3
C1-Phenanthrene/Anthracene	45.0	34.1	391.6	180.8	48.6	149.0	364.8	506.3	358.7	312.5	102.0
Fluoranthene	3.8	19.3	25.5	14.1	3.3	13.7	23.6	36.8	28.7	19.2	5.0
Pyrene	6.0	18.4	45.5	23.3	6.7	21.7	54.5	56.6	43.1	31.8	8.7
C2-Dibenzothiophene	4.4	2.1	18.1	10.8	3.2	7.7	20.6	30.7	13.6	17.0	5.7
C2-Phenanthrene/Anthracene	34.2	23.2	265.3	123.0	38.2	147.3	275.8	283.5	291.5	193.9	61.7
C3-Phenanthrene/Anthracene	11.1	10.2	85.1	46.3	23.2	36.5	138.8	96.5	61.9	40.4	34.0
Benz(a)anthracene	0.9	4.5	4.2	5.0	1.9	3.3	8.9	7.2	6.2	4.7	2.7
Chrysene	5.7	8.0	33.5	18.2	8.5	22.9	55.4	48.3	43.8	32.6	12.8
C4-Phenanthrene/Anthracene	5.0	5.0	23.8	17.0	6.6	14.4	29.8	53.0	28.3	19.4	7.7
Benzofluoranthenes	13.5	17.2	88.1	36.0	8.7	30.0	58.3	90.3	64.3	45.7	14.1
Benzo(e)pyrene	14.8	11.8	105.2	65.7	13.0	40.7	81.6	123.1	78.6	71.3	17.8
Benzo(a)pyrene	5.0	7.0	33.9	38.2	3.8	14.7	16.2	28.5	22.7	12.9	3.8
Perylene	40.3	32.4	289.8	141.8	39.5	93.2	239.9	299.1	188.9	146.3	53.8
Total	330.4	341.5	2730.9	1427.1	452.1	1137.5	3216.5	3249.6	2594.9	2308.1	953.8
Naphthalene AHD											
C0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C1	2.60	1.84	3.58	3.57	3.27	3.83	3.74	3.38	3.73	4.11	3.77
C2	6.33	3.88	7.96	6.77	6.52	7.38	6.79	7.89	7.46	10.64	6.45
C3	4.57	3.25	4.89	5.98	8.55	4.17	9.43	4.84	4.18	7.47	12.57
C4	1.25	0.82	1.70	2.17	7.39	1.50	6.26	1.81	1.93	3.40	8.45
Phenanthrene/anthracene AHD											
C0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C1	2.37	0.80	2.11	2.21	3.13	2.45	3.05	2.31	2.53	2.78	3.37
C2	1.80	0.54	1.43	1.50	2.46	2.43	2.30	1.29	2.06	1.72	2.04
C3	0.59	0.24	0.46	0.57	1.49	0.60	1.16	0.44	0.44	0.36	1.12
C4	0.26	0.12	0.13	0.21	0.43	0.24	0.25	0.24	0.20	0.17	0.25
Parent Compound Distribution (PCD)											
Naph	0.38	0.21	0.30	0.34	0.54	0.41	0.51	0.31	0.44	0.40	0.59
Fluor	0.15	0.11	0.17	0.14	0.15	0.18	0.19	0.15	0.14	0.12	0.19
DBT	0.09	0.05	0.10	0.06	0.13	0.10	0.13	0.09	0.11	0.12	0.15
Phen	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Pyr	0.52	0.88	0.38	0.46	0.64	0.58	0.65	0.43	0.51	0.45	0.45
BaA	0.35	0.29	0.20	0.28	0.67	0.43	0.54	0.25	0.35	0.33	0.51
BF/BP	2.84	1.16	2.03	2.18	3.11	2.03	2.49	1.78	1.79	1.71	2.24

Polycyclic aromatic hydrocarbon concentrations

Sample I.D.	3-01	3-04	3-07	3-09	3-10	3-12	3-17	3-20	3-26	3-30	3-33
Data I.D.	3/4	22/1	21/1	4/4	15/1	11/1	12/1	5/4	18/1	38/1	39/1
Naphthalene	36.0	2.7	35.0	10.0	77.5	27.3	68.4	48.0	73.8	67.3	73.0
C1-Naphthalene	140.0	8.7	123.8	41.0	94.6	116.9	269.8	180.0	268.6	252.4	229.3
Fluorene	14.0	1.0	19.3	5.0	138.2	19.2	32.0	20.0	28.1	27.8	26.8
C2-Naphthalene	260.0	26.6	270.8	91.0	224.9	248.6	521.4	390.0	569.2	633.5	565.8
C3-Naphthalene	260.0	22.9	199.5	99.0	98.4	150.8	280.8	350.0	426.7	472.3	274.3
C4-Naphthalene	110.0	4.6	64.6	50.0	198.8	126.0	187.1	140.0	155.8	249.2	82.6
Dibenzothiophene	10.0	0.7	11.0	3.0	79.4	20.4	18.9	8.0	18.4	23.1	16.1
Phenanthrene	68.0	5.4	72.5	20.0	553.6	75.9	145.0	90.0	148.7	163.5	139.9
Anthracene	0.1	0.0	0.1	0.1	34.7	5.1	0.1	0.1	3.9	21.7	8.8
C1-Dibenzothiophene	20.0	1.4	18.1	8.0	166.6	27.9	35.6	20.0	39.8	24.0	21.8
C1-Phenanthrene/Anthracene	180.0	14.5	181.9	61.0	1515.6	209.6	342.0	230.0	436.5	526.6	308.3
Fluoranthene	16.0	1.1	13.0	5.0	11.0	17.7	34.0	19.0	25.3	25.9	20.2
Pyrene	28.0	2.2	26.0	10.0	20.6	31.8	61.8	31.0	50.3	49.9	41.7
C2-Dibenzothiophene	14.0	0.6	0.7	4.0	6.9	26.5	23.7	5.0	30.0	8.0	12.6
C2-Phenanthrene/Anthracene	190.0	13.1	169.6	54.0	111.7	170.1	322.6	200.0	303.6	275.8	255.5
C3-Phenanthrene/Anthracene	120.0	5.6	70.6	35.0	59.3	136.2	170.1	110.0	159.1	124.6	74.3
Benz(a)anthracene	6.0	1.9	6.4	3.0	5.5	6.5	7.6	5.0	9.6	23.7	8.2
Chrysene	35.0	3.7	31.2	11.0	30.6	35.7	39.6	32.0	52.9	90.2	59.2
C4-Phenanthrene/Anthracene	15.0	1.1	7.4	8.0	29.3	25.6	53.9	18.0	15.4	66.8	25.9
Benzofluoranthenes	51.0	3.5	17.7	14.0	26.9	44.8	96.9	59.0	23.2	53.8	64.9
Benzo(e)pyrene	64.0	35.7	35.6	23.0	37.3	84.0	115.2	74.0	26.7	102.2	120.3
Benzo(a)pyrene	12.0	30.3	23.2	12.0	9.1	43.8	30.9	13.0	6.3	54.4	36.4
Perylene	160.0	43.2	69.6	54.0	95.4	166.3	297.8	200.0	59.3	249.3	264.4
Total	1809.1	230.6	1467.8	621.1	3626.0	1816.8	3155.3	2242.1	2931.3	3586.2	2730.2
Naphthalene AHD											
C0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C1	3.89	3.22	3.54	4.10	1.22	4.27	3.95	3.75	3.64	3.75	3.14
C2	7.22	9.87	7.74	9.10	2.90	9.09	7.62	8.13	7.71	9.41	7.75
C3	7.22	8.50	5.70	9.90	1.27	5.51	4.11	7.29	5.78	7.02	3.76
C4	3.06	1.70	1.85	5.00	2.56	4.61	2.74	2.92	2.11	3.70	1.13
Phenanthrene/anthracene AHD											
C0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C1	2.64	2.66	2.51	3.03	2.58	2.59	2.36	2.55	2.86	2.84	2.07
C2	2.79	2.40	2.34	2.69	0.19	2.10	2.22	2.22	1.99	1.49	1.72
C3	1.76	1.03	0.97	1.74	0.10	1.68	1.17	1.22	1.04	0.67	0.50
C4	0.22	0.21	0.10	0.40	0.05	0.32	0.37	0.20	0.10	0.36	0.17
Parent Compound Distribution (PCD)											
Naph	0.53	0.49	0.48	0.50	0.13	0.34	0.47	0.53	0.48	0.36	0.49
Fluor	0.21	0.18	0.27	0.25	0.23	0.24	0.22	0.22	0.18	0.15	0.18
DBT	0.15	0.12	0.15	0.15	0.14	0.25	0.13	0.09	0.12	0.12	0.11
Phen	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Pyr	0.65	0.62	0.54	0.75	0.05	0.61	0.66	0.55	0.50	0.41	0.42
BaA	0.60	1.03	0.52	0.70	0.06	0.52	0.33	0.41	0.41	0.62	0.45
BF/BP	3.10	8.55	1.21	3.38	0.21	2.61	2.72	2.87	0.54	1.64	2.22

Polycyclic aromatic hydrocarbon concentrations

Sample I.D.	4-01	4-05	4-10B	4-16	4-19	4-23	4-26	4-31	4-36B	4-39
Data I.D.	66/1	67/1	68/1	69/1	70/1	71/1	74/2	75/2	76/2	77/2
Naphthalene	58.4	14.6	68.1	56.0	62.1	3.8	24.5	50.5	2.3	76.2
C1-Naphthalene	174.2	50.5	239.9	193.4	227.6	9.4	87.5	218.2	10.2	53.6
Fluorene	21.1	5.8	18.1	22.2	19.9	1.2	8.7	16.9	1.0	3.2
C2-Naphthalene	494.4	117.1	476.7	386.5	501.2	34.5	177.0	450.2	29.9	73.2
C3-Naphthalene	397.5	122.7	451.0	342.7	533.7	108.1	157.2	370.6	25.5	66.0
C4-Naphthalene	264.8	68.9	247.6	206.6	286.5	61.5	74.4	187.9	25.9	34.2
Dibenzothiophene	17.1	3.7	16.7	15.7	17.5	0.6	4.6	14.2	0.7	2.3
Phenanthrene	128.8	29.5	122.3	109.0	110.1	8.7	43.4	87.5	5.9	15.2
Anthracene	8.6	1.7	6.2	6.3	4.7	0.9	2.9	4.0	0.3	1.3
C1-Dibenzothiophene	49.7	13.9	52.2	42.3	52.8	3.3	7.8	21.3	1.9	6.2
C1-Phenanthrene/Anthracene	355.0	97.7	366.7	316.9	371.9	28.8	144.9	393.8	35.6	97.4
Fluoranthene	30.8	6.5	25.7	25.3	28.9	4.6	15.2	32.4	5.0	10.4
Pyrene	53.9	13.1	48.8	45.0	48.8	6.9	25.9	64.5	12.0	21.7
C2-Dibenzothiophene	40.1	7.8	32.1	32.5	35.8	2.3	10.9	25.7	1.0	5.5
C2-Phenanthrene/Anthracene	251.8	70.5	277.0	229.6	290.1	26.4	118.2	320.2	35.4	82.2
C3-Phenanthrene/Anthracene	96.8	27.6	119.7	114.2	125.1	15.3	64.9	145.5	17.8	42.4
Benz(a)anthracene	7.0	1.9	6.0	7.0	6.9	1.4	2.7	4.9	0.8	1.9
Chrysene	40.0	12.2	42.9	41.6	44.3	4.6	14.6	30.4	4.5	10.0
C4-Phenanthrene/Anthracene	41.7	9.0	32.1	42.2	46.5	5.4	7.1	25.3	5.3	15.2
Benzofluoranthenes	46.8	14.3	56.1	42.7	47.8	5.7	29.4	55.5	6.9	16.8
Benzo(e)pyrene	69.5	17.8	82.4	60.9	67.6	4.5	36.2	85.0	7.6	23.3
Benzo(a)pyrene	16.3	3.8	15.4	12.3	13.2	1.5	8.9	14.8	1.6	5.2
Perylene	226.8	62.4	253.0	197.3	200.5	34.6	146.8	209.5	52.6	80.2
Total	2800.9	773.1	3056.9	2548.2	3143.7	374.1	1213.8	2828.8	289.6	743.7
Naphthalene AHD										
C0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C1	2.98	3.45	3.52	3.45	3.66	2.46	3.56	4.32	4.35	0.70
C2	8.47	8.00	7.00	6.90	8.07	9.01	7.21	8.91	12.72	0.96
C3	6.81	8.38	6.62	6.11	8.59	28.22	6.40	7.33	10.88	0.87
C4	4.54	4.70	3.63	3.69	4.61	16.06	3.03	3.72	11.02	0.45
Phenanthrene/anthracene AHD										
C0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C1	2.59	3.13	2.85	2.75	3.24	3.00	3.13	4.30	5.77	5.91
C2	1.83	2.26	2.15	1.99	2.53	2.75	2.56	3.50	5.73	4.99
C3	0.70	0.88	0.93	0.99	1.09	1.60	1.40	1.59	2.88	2.57
C4	0.30	0.29	0.25	0.37	0.41	0.56	0.15	0.28	0.86	0.92
Parent Compound Distribution (PCD)										
Naph	0.43	0.47	0.53	0.49	0.54	0.40	0.53	0.55	0.38	4.62
Fluor	0.15	0.19	0.14	0.19	0.17	0.12	0.19	0.18	0.16	0.20
DBT	0.12	0.12	0.13	0.14	0.15	0.06	0.10	0.16	0.11	0.14
Phen	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Pyr	0.62	0.63	0.58	0.61	0.68	1.20	0.89	1.06	2.76	1.95
BaA	0.34	0.45	0.38	0.42	0.45	0.63	0.37	0.39	0.85	0.72
BF/BP	1.99	2.46	2.40	2.08	2.16	4.20	3.81	2.89	9.64	5.89

Polycyclic aromatic hydrocarbon concentrations

Sample I.D.	5-01	5-05	5-13	5-13	5-13	5-16	5-17	5-20	5-24
Data I.D.	96/2	95/2	481/2	486/1	487/1	489/1	499/1	500/1	490/1
Naphthalene	3.9	4.0	21.4	22.5	22.1	46.9	59.3	59.5	60.6
C1-Naphthalene	51.0	13.9	98.8	94.6	93.9	184.7	226.5	240.7	241.7
Fluorene	15.1	4.4	10.2	12.2	10.0	20.8	30.5	25.2	27.2
C2-Naphthalene	337.8	37.8	191.0	184.7	186.2	351.5	399.4	383.5	450.1
C3-Naphthalene	892.6	139.0	170.5	133.8	132.5	237.9	196.3	193.9	324.3
C4-Naphthalene	421.0	126.4	56.7	31.3	32.0	55.0	84.0	58.6	77.3
Dibenzothiophene	19.0	3.5	6.5	7.5	6.3	10.5	16.7	16.0	16.7
Phenanthrene	48.6	13.0	41.8	38.8	40.6	83.0	117.5	110.3	104.1
Anthracene	0.1	0.1	0.2	0.5	0.4	0.6	1.0	0.8	0.6
C1-Dibenzothiophene	20.6	7.2	13.2	20.5	17.6	26.2	42.8	31.7	40.3
C1-Phenanthrene/Anthracene	55.3	27.7	141.3	176.9	148.0	243.8	423.7	345.2	346.4
Fluoranthene	0.4	2.8	11.2	12.2	12.1	18.9	26.0	23.2	28.0
Pyrene	1.0	3.7	20.3	23.1	22.8	38.0	47.9	43.7	49.1
C2-Dibenzothiophene	3.4	2.7	8.0	6.4	6.7	13.3	16.8	13.6	13.5
C2-Phenanthrene/Anthracene	24.6	23.5	110.4	124.9	124.8	194.4	266.3	217.4	281.5
C3-Phenanthrene/Anthracene	12.5	13.6	54.6	43.9	37.5	56.0	92.9	53.1	77.6
Benz(a)anthracene	0.3	1.1	3.1	3.5	3.5	4.7	6.7	6.3	6.2
Chrysene	0.7	3.2	19.6	21.3	21.5	33.6	43.5	43.1	47.3
C4-Phenanthrene/Anthracene	4.9	1.3	7.1	4.9	6.8	11.2	11.0	14.2	9.6
Benzofluoranthenes	0.4	3.6	21.2	22.6	21.3	42.4	51.6	56.9	54.1
Benzo(e)pyrene	0.7	3.3	31.1	32.4	35.5	64.4	75.2	89.4	82.6
Benzo(a)pyrene	0.3	1.0	6.9	6.1	6.6	9.7	15.8	16.2	11.3
Perylene	1.7	10.9	93.1	99.5	109.3	204.3	229.3	306.8	251.1
Total	1915.7	447.7	1138.2	1124.0	1097.9	1951.7	2480.8	2349.5	2601.2
Naphthalene AHD									
C0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C1	13.13	3.52	4.62	4.21	4.25	3.94	3.82	4.05	3.99
C2	86.94	9.57	8.93	8.22	8.44	7.49	6.73	6.45	7.43
C3	229.77	35.17	7.97	5.96	6.01	5.07	3.31	3.26	5.35
C4	108.36	31.99	2.65	1.39	1.45	1.17	1.42	0.99	1.28
Phenanthrene/anthracene AHD									
C0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C1	1.14	2.13	3.36	4.50	3.61	2.92	3.58	3.11	3.31
C2	0.51	1.80	2.63	3.18	3.04	2.33	2.25	1.96	2.69
C3	0.26	1.05	1.30	1.12	0.91	0.67	0.78	0.48	0.74
C4	0.10	0.10	0.17	0.12	0.17	0.13	0.09	0.13	0.09
Parent Compound Distribution (PCD)									
Naph	0.08	0.30	0.51	0.57	0.54	0.56	0.50	0.54	0.58
Fluor	0.31	0.34	0.24	0.31	0.24	0.25	0.26	0.23	0.26
DBT	0.39	0.27	0.15	0.19	0.15	0.13	0.14	0.14	0.16
Phen	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Pyr	0.03	0.50	0.75	0.90	0.85	0.68	0.62	0.60	0.74
BaA	0.02	0.34	0.54	0.63	0.61	0.46	0.42	0.44	0.51
BF/BP	0.04	1.11	2.72	3.11	3.18	2.95	2.37	3.27	2.92

Polycyclic aromatic hydrocarbon concentrations

Sample I.D.	5-26	5-29	5-33	5-35	5-36	5-61
Data I.D.	482/2	488/1	495/1	493/1	494/1	498/1
Naphthalene	21.1	45.0	19.2	18.7	28.9	3.6
C1-Naphthalene	163.1	197.2	92.7	90.8	111.7	13.2
Fluorene	38.7	21.8	29.8	26.4	12.6	3.4
C2-Naphthalene	703.1	364.5	322.4	239.8	192.7	43.0
C3-Naphthalene	1592.1	244.0	785.2	423.4	135.9	90.9
C4-Naphthalene	714.7	71.8	428.7	190.6	68.6	76.1
Dibenzothiophene	32.6	6.5	11.9	7.5	4.5	3.3
Phenanthrene	109.9	82.3	67.1	57.6	514.8	8.3
Anthracene	0.1	0.5	0.5	0.5	0.4	0.4
C1-Dibenzothiophene	43.4	16.7	15.7	10.8	9.4	8.9
C1-Phenanthrene/Anthracene	180.4	246.8	142.7	146.1	155.8	31.1
Fluoranthene	3.5	23.2	6.7	8.9	10.9	1.2
Pyrene	6.9	41.4	13.4	16.9	21.2	2.5
C2-Dibenzothiophene	8.2	7.3	5.2	3.0	3.9	1.2
C2-Phenanthrene/Anthracene	84.8	227.1	121.4	123.2	129.1	20.6
C3-Phenanthrene/Anthracene	37.9	74.9	36.2	41.4	47.5	5.9
Benz(a)anthracene	1.1	6.8	1.6	2.7	3.4	1.0
Chrysene	5.6	40.9	7.9	15.9	19.3	1.4
C4-Phenanthrene/Anthracene	3.7	6.8	12.1	11.2	3.1	5.7
Benzofluoranthenes	7.1	44.7	24.0	19.7	28.3	1.8
Benzo(e)pyrene	9.0	71.2	29.2	26.5	35.5	2.2
Benzo(a)pyrene	2.0	14.5	9.7	6.2	7.4	1.5
Perylene	32.3	209.8	96.8	82.3	102.1	9.9
Total	3801.1	2065.7	2280.1	1570.0	1646.9	337.1
Naphthalene AHD						
C0	1.00	1.00	1.00	1.00	1.00	1.00
C1	7.75	4.38	4.83	4.86	3.87	3.65
C2	33.40	8.10	16.78	12.82	6.67	11.90
C3	75.63	5.42	40.87	22.64	4.70	25.16
C4	33.95	1.59	22.32	10.19	2.37	21.07
Phenanthrene/anthracene AHD						
C0	1.00	1.00	1.00	1.00	1.00	1.00
C1	1.64	2.98	2.11	2.51	0.30	3.58
C2	0.77	2.74	1.80	2.12	0.25	2.38
C3	0.34	0.90	0.54	0.71	0.09	0.68
C4	0.03	0.08	0.18	0.19	0.01	0.66
Parent Compound Distribution (PCD						
Naph	0.19	0.54	0.28	0.32	0.06	0.42
Fluor	0.35	0.26	0.44	0.45	0.02	0.39
DBT	0.30	0.08	0.18	0.13	0.01	0.38
Phen	1.00	1.00	1.00	1.00	1.00	1.00
Pyr	0.10	0.78	0.30	0.44	0.06	0.43
BaA	0.06	0.58	0.14	0.32	0.04	0.27
BF/BP	0.36	3.07	1.79	1.76	0.25	1.35

Polycyclic aromatic hydrocarbon concentrations

Sample I.D.	6-02	6-04	6-04	6-05	6-05	6-11	6-15	6-15	6-21
Data I.D.	3268/1	3276/1	3279/1	3244/1	3247/1	3269/1	3274/1	3275/1	3267/1
Naphthalene	49.0	50.0	46.0	24.0	26.0	46.0	76.0	72.0	60.0
C1-Naphthalene	180.0	210.0	250.0	39.0	93.0	190.0	280.0	250.0	240.0
Fluorene	14.0	28.0	26.0	0.1	0.1	14.0	24.0	21.0	9.0
C2-Naphthalene	350.0	740.0	730.0	120.0	140.0	300.0	480.0	470.0	320.0
C3-Naphthalene	350.0	840.0	810.0	85.0	86.0	220.0	320.0	310.0	200.0
C4-Naphthalene	130.0	420.0	470.0	36.0	29.0	92.0	120.0	130.0	68.0
Dibenzothiophene	16.0	32.0	32.0	0.1	0.1	14.0	20.0	21.0	12.0
Phenanthrene	200.0	140.0	110.0	1.0	1.0	120.0	160.0	170.0	150.0
Anthracene	0.4	2.0	5.0	0.0	0.0	0.5	0.3	0.2	0.1
C1-Dibenzothiophene	11.0	12.0	46.0	0.0	0.0	12.0	6.0	6.0	2.0
C1-Phenanthrene/Anthracene	440.0	330.0	330.0	1.0	2.0	310.0	360.0	420.0	450.0
Fluoranthene	61.0	18.0	20.0	6.0	5.0	22.0	18.0	24.0	18.0
Pyrene	61.0	28.0	33.0	14.0	12.0	40.0	39.0	39.0	39.0
C2-Dibenzothiophene	2.0	13.0	26.0	0.0	0.0	4.0	4.0	5.0	2.0
C2-Phenanthrene/Anthracene	120.0	140.0	160.0	50.0	44.0	150.0	150.0	140.0	140.0
C3-Phenanthrene/Anthracene	24.0	18.0	70.0	6.0	4.0	33.0	10.0	9.0	12.0
Benz(a)anthracene	0.6	0.2	3.0	0.2	0.2	0.9	0.3	0.4	0.3
Chrysene	46.0	36.0	45.0	12.0	6.0	57.0	49.0	63.0	43.0
C4-Phenanthrene/Anthracene	0.2	0.2	3.0	0.1	0.2	0.4	0.3	0.3	2.0
Benzofluoranthenes	7.0	1.0	9.0	2.0	0.6	12.0	4.0	2.0	7.0
Benzo(e)pyrene	49.0	30.0	42.0	17.0	11.0	57.0	48.0	0.0	60.0
Benzo(a)pyrene	0.4	0.5	0.3	0.6	0.6	0.6	1.0	0.0	0.5
Perylene	200.0	220.0	110.0	160.0	110.0	380.0	270.0	0.0	360.0
Total	2311.6	3308.9	3376.3	574.1	570.7	2075.4	2439.9	2152.9	2194.9
Naphthalene AHD									
C0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C1	3.67	4.20	5.43	1.63	3.58	4.13	3.68	3.47	4.00
C2	7.14	14.80	15.87	5.00	5.38	6.52	6.32	6.53	5.33
C3	7.14	16.80	17.61	3.54	3.31	4.78	4.21	4.31	3.33
C4	2.65	8.40	10.22	1.50	1.12	2.00	1.58	1.81	1.13
Phenanthrene/anthracene AHD									
C0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C1	2.20	2.32	2.87	1.00	2.00	2.57	2.25	2.47	3.00
C2	0.60	0.99	1.39	50.00	44.00	1.24	0.94	0.82	0.93
C3	0.12	0.13	0.61	6.00	4.00	0.27	0.06	0.05	0.08
C4	0.00	0.00	0.03	0.10	0.20	0.00	0.00	0.00	0.01
Parent Compound Distribution (PCD)									
Naph	0.24	0.35	0.40	24.00	26.00	0.38	0.47	0.42	0.40
Fluor	0.07	0.20	0.23	0.10	0.08	0.12	0.15	0.12	0.06
DBT	0.08	0.23	0.28	0.10	0.05	0.12	0.12	0.12	0.08
Phen	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Pyr	0.61	0.32	0.46	20.00	17.00	0.51	0.36	0.37	0.38
BaA	0.23	0.25	0.42	12.20	6.20	0.48	0.31	0.37	0.29
BF/BP	1.03	1.56	1.03	162.00	110.60	3.25	1.71	0.01	2.45

Polycyclic aromatic hydrocarbon concentrations

Sample I.D.	6-22	6-27	6-35	6-41	6-41	6-44
Data I.D.	3243/1	3266/1	3280/1	3273/1	3278/1	3246/1
Naphthalene	70.0	62.0	47.0	47.0	48.0	100.0
C1-Naphthalene	270.0	220.0	170.0	160.0	180.0	130.0
Fluorene	0.4	6.0	12.0	12.0	18.0	0.3
C2-Naphthalene	440.0	290.0	280.0	420.0	200.0	310.0
C3-Naphthalene	310.0	160.0	200.0	380.0	410.0	270.0
C4-Naphthalene	140.0	57.0	74.0	120.0	180.0	130.0
Dibenzothiophene	0.4	8.0	11.0	15.0	20.0	0.3
Phenanthrene	3.0	130.0	94.0	99.0	110.0	3.0
Anthracene	0.0	0.1	0.4	0.3	2.0	0.0
C1-Dibenzothiophene	0.2	2.0	4.0	5.0	12.0	0.1
C1-Phenanthrene/Anthracene	10.0	300.0	270.0	310.0	240.0	6.0
Fluoranthene	26.0	6.0	12.0	13.0	25.0	18.0
Pyrene	46.0	24.0	28.0	28.0	41.0	36.0
C2-Dibenzothiophene	0.2	0.3	4.0	0.1	12.0	0.1
C2-Phenanthrene/Anthracene	22.0	66.0	110.0	93.0	160.0	150.0
C3-Phenanthrene/Anthracene	44.0	6.0	10.0	21.0	35.0	22.0
Benz(a)anthracene	2.0	0.5	0.2	0.2	3.0	1.0
Chrysene	70.0	37.0	25.0	30.0	54.0	55.0
C4-Phenanthrene/Anthracene	3.0	2.0	0.2	0.2	4.0	0.8
Benzofluoranthenes	26.0	4.0	1.0	0.3	11.0	9.0
Benzo(e)pyrene	71.0	51.0	32.0	33.0	55.0	60.0
Benzo(a)pyrene	0.3	2.0	0.4	0.8	1.0	33.0
Perylene	280.0	0.0	0.0	160.0	0.0	0.2
Total	1834.5	1433.9	1385.2	1947.9	1821.0	1334.8
Naphthalene AHD						
C0	1.00	1.00	1.00	1.00	1.00	1.00
C1	3.86	3.55	3.62	3.40	3.75	1.30
C2	6.29	4.68	5.96	8.94	4.17	3.10
C3	4.43	2.58	4.26	8.09	8.54	2.70
C4	2.00	0.92	1.57	2.55	3.75	1.30
Phenanthrene/anthracene AHD						
C0	1.00	1.00	1.00	1.00	1.00	1.00
C1	3.32	2.31	2.86	3.12	2.14	1.99
C2	7.31	0.51	1.17	0.94	1.43	49.83
C3	14.62	0.05	0.11	0.21	0.31	7.31
C4	1.00	0.02	0.00	0.00	0.04	0.27
Parent Compound Distribution (PCD)						
Naph	23.26	0.48	0.50	0.47	0.43	33.22
Fluor	0.13	0.05	0.13	0.12	0.16	0.10
DBT	0.13	0.06	0.12	0.15	0.18	0.10
Phen	1.00	1.00	1.00	1.00	1.00	1.00
Pyr	23.92	0.23	0.42	0.41	0.59	17.94
BaA	23.92	0.29	0.27	0.30	0.51	18.60
BF/BP	101.66	0.03	0.01	1.61	0.10	3.06

APPENDIX E

NON-POLAR HYDROCARBON DATA FOR INDIVIDUAL COMPONENTS IN 9 SAMPLES ANALYZED IN DUPLICATE AS "BLIND" SAMPLES

Non polar hydrocarbon replicates

Sample I.	2-09	2-09	2-09	2-09	2-09	2-12	2-12	2-12	2-12	2-12
Data I.D.	359/2	444/2	Mean	std dev	rel % sd	371/2	445/2	Mean	std dev	rel % sd
nC10 d22										
nC10	14	23	18.5	9	48.6	4	6	5	2	40.0
nC11	14	380	197	366	185.8	7	100	53.5	93	173.8
nC12	18	78	48	60	125.0	11	6	8.5	5	58.8
Norf (a)	3	0	1.5	3	200.0	2	0	1	2	200.0
Norf (b)	3	0	1.5	3	200.0	2	0	1	2	200.0
Norf (c)	3	0	1.5	3	200.0	2	0	1	2	200.0
Norf (d)	3	0	1.5	3	200.0	2	0	1	2	200.0
Norf (e)	3	0	1.5	3	200.0	6	0	3	6	200.0
nC13	58	160	109	102	93.6	21	8	14.5	13	89.7
Farnesane	49	70	59.5	21	35.3	10	6	8	4	50.0
nC14	150	280	215	130	60.5	40	18	29	22	75.9
Trimethyl	190	250	220	60	27.3	33	21	27	12	44.4
nC15	360	430	395	70	17.7	63	38	50.5	25	49.5
nC16	590	500	545	90	16.5	82	55	68.5	27	39.4
Norprista	450	430	440	20	4.5	38	41	39.5	3	7.6
nC17	910	690	800	220	27.5	110	99	104.5	11	10.5
Pristane	730	620	675	110	16.3	94	84	89	10	11.2
nC18	810	680	745	130	17.4	93	94	93.5	1	1.1
Phytane	540	540	540	0	0.0	72	62	67	10	14.9
nC19	820	660	740	160	21.6	130	110	120	20	16.7
nC20	680	700	690	20	2.9	100	150	125	50	40.0
nC21	660	960	810	300	37.0	110	170	140	60	42.9
nC22	620	660	640	40	6.2	92	110	101	18	17.8
nC23	640	790	715	150	21.0	120	120	120	0	0.0
nC24	510	510	510	0	0.0	76	80	78	4	5.1
nC25	810	770	790	40	5.1	130	110	120	20	16.7
nC26	460	490	475	30	6.3	64	52	58	12	20.7
nC27	760	860	810	100	12.3	160	120	140	40	28.6
nC28	390	320	355	70	19.7	64	41	52.5	23	43.8
nC29	580	900	740	320	43.2	130	120	125	10	8.0
nC30	300	450	375	150	40.0	50	40	45	10	22.2
nC31	420	520	470	100	21.3	100	73	86.5	27	31.2
nC32	220	480	350	260	74.3	50	36	43	14	32.6
nC33	140	240	190	100	52.6	53	31	42	22	52.4
nC34	88	69	78.5	19	24.2	26	11	18.5	15	81.1
nC35	58	48	53	10	18.9	18	12	15	6	40.0
nC36	29	48	38.5	19	49.4	12	13	12.5	1	8.0
nC37	17	10	13.5	7	51.9	8	3	5.5	5	90.9
nC38	4	10	7	6	85.7	3	3	3	0	0.0
Total NPH	13104	14626	13865	1522	11.0	2188	2043	2115.5	145	6.9
Isoprenoi	1974	1910	1942	64	3.3	261	214	237.5	47	19.8
Total n-a	11130	12716	11923	1586	13.3	1927	1829	1878	98	5.2
nC11-nC13	90	618	354	528	149.2	39	114	76.5	75	98.0

Non polar hydrocarbon replicates

Sample I.	3-07	3-07	3-07	3-07	3-07
Data I.D.	449/2	822/7	Mean	std dev	rel % sd
nC10 d22					
nC10	18	3	10.5	15	142.9
nC11	160	3	81.5	157	192.6
nC12	18	15	16.5	3	18.2
Norf (a)	0	3	1.5	3	200.0
Norf (b)	0	3	1.5	3	200.0
Norf (c)	0	3	1.5	3	200.0
Norf (d)	0	3	1.5	3	200.0
Norf (e)	0	3	1.5	3	200.0
nC13	17	36	26.5	19	71.7
Farnesane	16	18	17	2	11.8
nC14	24	72	48	48	100.0
Trimethyl	32	69	50.5	37	73.3
nC15	74	150	112	76	67.9
nC16	140	210	175	70	40.0
Norprista	83	120	101.5	37	36.5
nC17	290	440	365	150	41.1
Pristane	240	220	230	20	8.7
nC18	310	300	305	10	3.3
Phytane	200	210	205	10	4.9
nC19	350	400	375	50	13.3
nC20	370	250	310	120	38.7
nC21	330	330	330	0	0.0
nC22	300	300	300	0	0.0
nC23	340	330	335	10	3.0
nC24	210	230	220	20	9.1
nC25	310	320	315	10	3.2
nC26	170	180	175	10	5.7
nC27	320	370	345	50	14.5
nC28	120	170	145	50	34.5
nC29	330	260	295	70	23.7
nC30	160	100	130	60	46.2
nC31	190	120	155	70	45.2
nC32	93	26	59.5	67	112.6
nC33	58	49	53.5	9	16.8
nC34	36	33	34.5	3	8.7
nC35	35	5	20	30	150.0
nC36	8	5	6.5	3	46.2
nC37	8	5	6.5	3	46.2
nC38	8	5	6.5	3	46.2
Total NPH	5368	5369	5368.5	1	0.0
Isoprenoi	571	652	611.5	81	13.2
Total n-a	4797	4717	4757	80	1.7
nC11-nC13	195	54	124.5	141	113.3

Sample I.	3-20	3-20	3-20	3-20	3-20
Data I.D.	446/2	835/7	Mean	std dev	rel % sd
nC10 d22					
nC10	23	6	14.5	17	117.2
nC11	290	5	147.5	285	193.2
nC12	60	26	43	34	79.1
Norf (a)	0	5	2.5	5	200.0
Norf (b)	0	5	2.5	5	200.0
Norf (c)	0	5	2.5	5	200.0
Norf (d)	0	5	2.5	5	200.0
Norf (e)	0	5	2.5	5	200.0
nC13	120	76	98	44	44.9
Farnesane	65	45	55	20	36.4
nC14	220	140	180	80	44.4
Trimethyl	190	120	155	70	45.2
nC15	300	270	285	30	10.5
nC16	360	300	330	60	18.2
Norprista	250	160	205	90	43.9
nC17	580	510	545	70	12.8
Pristane	390	280	335	110	32.8
nC18	590	310	450	280	62.2
Phytane	380	220	300	160	53.3
nC19	480	350	415	130	31.3
nC20	610	290	450	320	71.1
nC21	560	290	425	270	63.5
nC22	510	240	375	270	72.0
nC23	560	260	410	300	73.2
nC24	370	170	270	200	74.1
nC25	570	240	405	330	81.5
nC26	370	110	240	260	108.3
nC27	590	270	430	320	74.4
nC28	370	60	215	310	144.2
nC29	630	190	410	440	107.3
nC30	340	67	203.5	273	134.2
nC31	360	80	220	280	127.3
nC32	320	25	172.5	295	171.0
nC33	230	30	130	200	153.8
nC34	88	15	51.5	73	141.7
nC35	35	8	21.5	27	125.6
nC36	24	8	16	16	100.0
nC37	5	8	6.5	3	46.2
nC38	5	8	6.5	3	46.2
Total NPH	10845	5212	8028.5	5633	70.2
Isoprenoi	1275	850	1062.5	425	40.0
Total n-a	9570	4362	6966	5208	74.8
nC11-nC13	470	107	288.5	363	125.8

Non polar hydrocarbon replicates

Sample I.	5-05	5-05	5-05	5-05	5-05	5-11	5-11	5-11	5-11	5-11
Data I.D.	457/3	3203/2	Mean	std dev	rel % sd	560/2	571/2	Mean	std dev	rel % sd
nC10 d22										
nC10	3	9	6	6	100.0	6	20	13	14	107.7
nC11	3	130	66.5	127	191.0	6	19	12.5	13	104.0
nC12	3	340	171.5	337	196.5	310	390	350	80	22.9
Norf (a)	83	270	176.5	187	105.9	250	270	260	20	7.7
Norf (b)	140	260	200	120	60.0	460	540	500	80	16.0
Norf (c)	460	490	475	30	6.3	320	420	370	100	27.0
Norf (d)	280	620	450	340	75.6	580	680	630	100	15.9
Norf (e)	510	1200	855	690	80.7	1900	1500	1700	400	23.5
nC13	500	640	570	140	24.6	1100	880	990	220	22.2
Farnesane	650	1300	975	650	66.7	1000	970	985	30	3.0
nC14	330	420	375	90	24.0	460	410	435	50	11.5
Trimethyl	1000	1400	1200	400	33.3	1300	2000	1650	700	42.4
nC15	490	620	555	130	23.4	430	530	480	100	20.8
nC16	390	600	495	210	42.4	460	470	465	10	2.2
Norprista	790	1000	895	210	23.5	980	1100	1040	120	11.5
nC17	95	310	202.5	215	106.2	390	340	365	50	13.7
Pristane	1300	1200	1250	100	8.0	1400	1600	1500	200	13.3
nC18	150	58	104	92	88.5	140	230	185	90	48.6
Phytane	1400	560	980	840	85.7	720	830	775	110	14.2
nC19	31	12	21.5	19	88.4	200	170	185	30	16.2
nC20	100	64	82	36	43.9	170	130	150	40	26.7
nC21	36	15	25.5	21	82.4	120	110	115	10	8.7
nC22	36	16	26	20	76.9	84	75	79.5	9	11.3
nC23	44	17	30.5	27	88.5	88	56	72	32	44.4
nC24	29	18	23.5	11	46.8	44	34	39	10	25.6
nC25	42	19	30.5	23	75.4	49	38	43.5	11	25.3
nC26	19	20	19.5	1	5.1	17	24	20.5	7	34.1
nC27	50	21	35.5	29	81.7	32	25	28.5	7	24.6
nC28	14	22	18	8	44.4	7	26	16.5	19	115.2
nC29	35	23	29	12	41.4	7	26	16.5	19	115.2
nC30	4	23	13.5	19	140.7	7	27	17	20	117.6
nC31	19	24	21.5	5	23.3	7	27	17	20	117.6
nC32	4	24	14	20	142.9	8	28	18	20	111.1
nC33	4	25	14.5	21	144.8	8	28	18	20	111.1
nC34	4	26	15	22	146.7	8	29	18.5	21	113.5
nC35	5	27	16	22	137.5	8	31	19.5	23	117.9
nC36	5	29	17	24	141.2	9	32	20.5	23	112.2
nC37	5	29	17	24	141.2	9	32	20.5	23	112.2
nC38	5	29	17	24	141.2	9	32	20.5	23	112.2
Total NPH	9068	11910	10489	2842	27.1	13103	14179	13641	1076	7.9
Isoprenoi	6613	8300	7456.5	1687	22.6	8910	9910	9410	1000	10.6
Total n-a	2455	3610	3032.5	1155	38.1	4193	4269	4231	76	1.8
nC11-nC13	506	1110	808	604	74.8	1416	1289	1352.5	127	9.4

Non polar hydrocarbon replicates

Sample I.	6-05	6-05	6-05	6-05	6-05	6-15	6-15	6-15	6-15	6-15
Data I.D.	3144/2	3178/1	Mean	std dev	rel % sd	3149/1	3179/1	Mean	std dev	rel % sd
nC10 d22	19	3	11	16	145.5	340	450	395	110	27.8
nC10	3	48	25.5	45	176.5	250	460	355	210	59.2
nC11	180	210	195	30	15.4	3100	5000	4050	1900	46.9
nC12	120	150	135	30	22.2	1900	2200	2050	300	14.6
Norf (a)	85	120	102.5	35	34.1	820	1100	960	280	29.2
Norf (b)	49	66	57.5	17	29.6	510	650	580	140	24.1
Norf (c)	85	120	102.5	35	34.1	810	1100	955	290	30.4
Norf (d)	46	70	58	24	41.4	480	640	560	160	28.6
Norf (e)	97	120	108.5	23	21.2	1100	1300	1200	200	16.7
nC13	160	170	165	10	6.1	1400	1400	1400	0	0.0
Farnesane	81	230	155.5	149	95.8	1500	1800	1650	300	18.2
nC14	68	170	119	102	85.7	1300	1300	1300	0	0.0
Trimethyl	89	170	129.5	81	62.5	1400	1400	1400	0	0.0
nC15	110	150	130	40	30.8	1600	1400	1500	200	13.3
nC16	96	100	98	4	4.1	750	850	800	100	12.5
Norprista	81	140	110.5	59	53.4	550	730	640	180	28.1
nC17	96	130	113	34	30.1	720	830	775	110	14.2
Pristane	120	160	140	40	28.6	750	810	780	60	7.7
nC18	65	82	73.5	17	23.1	440	580	510	140	27.5
Phytane	57	62	59.5	5	8.4	330	390	360	60	16.7
nC19	50	74	62	24	38.7	420	460	440	40	9.1
nC20	0	44	22	44	200.0	420	300	360	120	33.3
nC21	33	49	41	16	39.0	290	310	300	20	6.7
nC22	21	35	28	14	50.0	240	240	240	0	0.0
nC23	25	40	32.5	15	46.2	270	320	295	50	16.9
nC24	18	26	22	8	36.4	190	200	195	10	5.1
nC25	24	37	30.5	13	42.6	260	300	280	40	14.3
nC26	10	17	13.5	7	51.9	120	140	130	20	15.4
nC27	31	45	38	14	36.8	310	400	355	90	25.4
nC28	18	6	12	12	100.0	120	140	130	20	15.4
nC29	19	43	31	24	77.4	210	350	280	140	50.0
nC30	6	6	6	0	0.0	31	74	52.5	43	81.9
nC31	6	47	26.5	41	154.7	130	280	205	150	73.2
nC32	6	6	6	0	0.0	35	130	82.5	95	115.2
nC33	6	6	6	0	0.0	16	19	17.5	3	17.1
nC34	6	7	6.5	1	15.4	19	20	19.5	1	5.1
nC35	6	7	6.5	1	15.4	18	20	19	2	10.5
nC36	7	7	7	0	0.0	17	21	19	4	21.1
nC37										
nC38										
Total NPH	1980	2970	2475	990	40.0	22826	27664	25245	4838	19.2
Isoprenoi	790	1258	1024	468	45.7	8250	9920	9085	1670	18.4
Total n-a	1190	1712	1451	522	36.0	14576	17744	16160	3168	19.6
nC11-nC13	460	530	495	70	14.1	6400	8600	7500	2200	29.3

Non polar hydrocarbon replicates

Sample I.	6-41	6-41	6-41	6-41	6-41	7-02	7-03	sed trap	sed trap	sed trap
Data I.D.	3168/1	3174/1	Mean	std dev	rel % sd	3180/1	3182/1	Mean	std dev	rel % sd
nC10 d22	630	790	710	160	22.5	410	950	680	540	79.4
nC10	630	990	810	360	44.4	710	340	525	370	70.5
nC11	15000	14000	14500	1000	6.9	15000	4800	9900	10200	103.0
nC12	6100	5700	5900	400	6.8	9300	2500	5900	6800	115.3
Norf (a)	3100	2900	3000	200	6.7	4300	540	2420	3760	155.4
Norf (b)	1800	1700	1750	100	5.7	2900	1200	2050	1700	82.9
Norf (c)	3200	2800	3000	400	13.3	4100	1300	2700	2800	103.7
Norf (d)	1900	1600	1750	300	17.1	2600	700	1650	1900	115.2
Norf (e)	3200	3400	3300	200	6.1	5400	240	2820	5160	183.0
nC13	300	3900	2100	3600	171.4	4700	1100	2900	3600	124.1
Farnesane	3800	3900	3850	100	2.6	7100	2000	4550	5100	112.1
nC14	1900	2500	2200	600	27.3	3900	1100	2500	2800	112.0
Trimethyl	2000	2300	2150	300	14.0	5800	2100	3950	3700	93.7
nC15	1300	1700	1500	400	26.7	3400	910	2155	2490	115.5
nC16	460	540	500	80	16.0	1400	530	965	870	90.2
Norprista	510	710	610	200	32.8	1300	480	890	820	92.1
nC17	370	570	470	200	42.6	1100	460	780	640	82.1
Pristane	530	720	625	190	30.4	1500	870	1185	630	53.2
nC18	240	270	255	30	11.8	320	320	320	0	0.0
Phytane	200	250	225	50	22.2	380	360	370	20	5.4
nC19	210	300	255	90	35.3	350	240	295	110	37.3
nC20	180	180	180	0	0.0	190	190	190	0	0.0
nC21	170	160	165	10	6.1	210	170	190	40	21.1
nC22	140	120	130	20	15.4	150	120	135	30	22.2
nC23	170	130	150	40	26.7	170	140	155	30	19.4
nC24	120	82	101	38	37.6	99	79	89	20	22.5
nC25	180	110	145	70	48.3	140	110	125	30	24.0
nC26	97	49	73	48	65.8	63	41	52	22	42.3
nC27	220	120	170	100	58.8	170	100	135	70	51.9
nC28	76	35	55.5	41	73.9	63	0.2	31.6	62.8	198.7
nC29	150	85	117.5	65	55.3	130	47	88.5	83	93.8
nC30	80	38	59	42	71.2	25	0.2	12.6	24.8	196.8
nC31	87	38	62.5	49	78.4	100	0.2	50.1	99.8	199.2
nC32	84	38	61	46	75.4	50	0.2	25.1	49.8	198.4
nC33	87	39	63	48	76.2	26	0.2	13.1	25.8	196.9
nC34	90	40	65	50	76.9	27	0.2	13.6	26.8	197.1
nC35	95	43	69	52	75.4	27	0.2	13.6	26.8	197.1
nC36	100	46	73	54	74.0	28	0.2	14.1	27.8	197.2
nC37										
nC38										
Total NPH	48876	52103	50489.5	3227	6.4	77228	23088.6	50158.3	54139.4	107.9
Isoprenoi	20240	20280	20260	40	0.2	35380	9790	22585	25590	113.3
Total n-a	28636	31823	30229.5	3187	10.5	41848	13298.6	27573.3	28549.4	103.5
nC11-nC13	21400	23600	22500	2200	9.8	29000	8400	18700	20600	110.2